

A taxonomic review of the common green lacewing genus *Chrysoperla* (Neuroptera: Chrysopidae)

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SYNOPSIS. The genus *Chrysoperla* Steinmann (Neuroptera: Chrysopidae), world-wide distribution, is revised. Several species of the genus, and in particular *Chrysoperla carnea* (Stephens), are cultured extensively for use in biological control programmes but until now the systematics of the genus has remained confused. 36 species are recognized as valid. Five new species are described, 4 species have revised status and there are 40 new specific synonyms, one new provisional synonym and four lectotype designations. Eight species are newly excluded from *Chrysoperla*. A key to the species is provided. Male and female of each species are described and diagnostic features figured.

INTRODUCTION

More effort has been spent on research into the ecology and biology of *Chrysoperla* than all the rest of the chrysopid genera put together (see Canard *et al.*, 1984). This is chiefly because several species, but especially *C. carnea* (Stephens), have proved easy to culture and their larvae are fierce predators of aphids and coccids. *C. carnea* and some of its congeners are now commonly reared in biological control laborato-

ries all over the world. One aspect that has been largely overlooked, however, is the systematics of the genus as a whole.

Following a genus-level revision of the Chrysopidae (Brooks & Barnard, 1990), *Chrysoperla* is now clearly defined and it is possible to correctly assign species to the genus. As currently recognized, the genus includes 36 species, distributed throughout the world but with a preponderance of Holarctic species. Although it is relatively easy to recognize which species belong to the genus, species level identi-

cation is less straight forward. Tjeder (1966) provided a key to five species from southern Africa and Hölzel (1989b) gave descriptions of a further five Afrotropical species. Three western European species can be identified using the keys in Aspöck *et al.* (1980). In order to identify the remaining Old World species it is usually necessary to compare the frequently inadequate original descriptions that are scattered throughout the literature often in old and obscure volumes. The New World also has a rich *Chrysoperla* fauna but similar identification problems will be encountered as there are no modern keys available to identify the adults, although Tauber (1974) provided descriptions of the North American larvae.

A further complication when trying to establish the correct name for a particular *Chrysoperla* specimen is that, although a few identification keys are available for particular regions, regional faunas have never been compared with each other. This has undoubtedly led to synonymy and this study shows that some species occur in more than one zoogeographic region where they were referred to under different names.

In recent years traditional morphological taxonomic studies of *Chrysoperla* species, especially those in the *C. carnea* species-complex, have been supplemented by investigations employing additional techniques. One example is the pioneering work begun by Henry (1979) who studied the production of substrate-borne calls by males and females during courtship. This work has necessitated a reappraisal of species limits because morphologically identical populations have been shown to be reproductively isolated by their different courtship songs (Henry, 1983). A useful summary of this work appears in Henry (1992). Other new approaches include multivariate analysis of morphological characters (Thierry *et al.*, 1992), morphometric studies of the male genitalia (Séméria, 1992) and electrophoretic studies (Cianchi & Bullini, 1992). These and other studies on the *Chrysoperla carnea*-complex are discussed by Thierry & Adams (1992).

These recent investigations have produced some fascinating results and point up some of the limitations of a traditional morphological taxonomic study. However, a thorough revision of the genus on a worldwide basis is an essential prerequisite if we are to interpret the phylogenetic relationships of the species within the genus. Such a revision will also establish the geographic distribution of the morpho-species and the extent of geographical variation within taxa. The new techniques described above have only been applied to a few populations in western Europe and North America where a plentiful

supply of material is readily available. In order to conduct a comprehensive revision of the world species it is necessary to fall back on a morphological study of long-dead material stored in museum collections.

This study is the first revision of the world species of this economically important genus. As a result of this work 36 species are now recognized as valid and these are described and figured. Five new species are described, 4 species have new status, 40 new specific synonyms, three revised synonyms and one provisional synonym are proposed. The aim of this work is to provide an overview of the species of *Chrysoperla* and a baseline for future taxonomic work, using a wider range of techniques.

In general, I have decided to recognise as species those taxa that have clearly defined, unambiguous, morphological characters. Such characters are usually derived from features of the male genitalia but include other characters too. Geographical variation within each species is described. Such variation may be indicative of sibling species that may be more clearly revealed using some of the techniques described above. A few species have recently been described that are distinguishable only by the courtship songs that they produce or by certain aspects of their ecology. I have not synonymised these taxa since the biological evidence is compelling and active research is still in progress.

HISTORICAL REVIEW

Generic classification

Chrysoperla was first proposed by Steinmann (1964) as one of four subgenera of *Chrysopa* Leach. The subgenera were based on differences in head markings. However, characters such as these have proved to be unreliable in defining supraspecific monophyletic groups (Brooks & Barnard, 1990) and Steinmann's subgenera have no validity as he defined them. The systematics of Chrysopidae was revolutionized when Tjeder (1966) recognized that the presence or absence of certain components in the male genitalia united groups of species in the otherwise homogeneous genus *Chrysopa* s.l. Until then this large and unwieldy taxon included the large majority of chrysopid species. Tjeder considered these groups of species as subgenera of *Chrysopa*. One of the eight subgenera he recognized included those species in which the arcuate dorsal structure in the male genitalia, termed the tignum,

was present but the gonapsis, a ventral winged structure, was absent. This species group included *C. carnea* (Stephens) which Steinmann had nominated the type-species of *Chrysoperla*. Tjeder (1966) included 17 species in *Chrysoperla* which were divided between two species groups. The second of these species groups is now considered to be a distinct genus, *Atlantochrysa* Hölzel (Brooks & Barnard, 1990). Following Tjeder's lead, Hölzel (1970) revised the generic classification of the Palearctic Chrysopinae. Hölzel accorded full generic status to some of the more distinctive taxa previously grouped together in *Chrysopa* s.l. but those groups in which males possessed a tignum and/or gonapsis, including *Chrysoperla*, were included together as subgenera of *Anisochrysa* Nakahara (now *Mallada* Navás).

Séméria (1977) later raised *Chrysoperla* to full generic status. He showed that species of *Chrysoperla* were distinct from those of *Anisochrysa* in three principal ways. First, males of *Anisochrysa* possess a gonapsis, which is absent in *Chrysoperla*, secondly larvae of *Anisochrysa* carry debris but are naked in *Chrysoperla* and finally, the adult is the over-wintering stage in *Chrysoperla* but in *Anisochrysa* it is the third instar larva that over-winters.

Electrophoretic studies by Bullini *et al.* (1984) supported the recognition of *Chrysoperla* as distinct from other chrysopid genera and moreover demonstrated that it was more closely related to *Anisochrysa* (= *Mallada*) than to *Chrysopa* Leach.

The first genus-level revision of the world Chrysopidae was published by Brooks & Barnard (1990). In that paper, *Chrysoperla* was demonstrated to be monophyletic, closely related to but distinct from *Mallada*. As well as the characters noted by previous workers as distinguishing *Chrysoperla*, additional autapomorphies for the genus were identified.

Species classification

Although the species of *Chrysoperla* are superficially rather homogeneous, there is considerable variation in the extent and colour of markings, especially on the head, within and between taxa. Many of the taxa are also common, abundant and widely distributed. This combination of factors has led to a plethora of species-group names appearing in the literature. During this study 112 species-group names assignable to *Chrysoperla* were traced (plus numerous varietal names) but I have treated only 36 as valid.

The wide distributional range and degree of

morphological variation between populations of some *Chrysoperla* species led some authors to doubt whether these taxa are true biological entities. In order to tackle this problem some workers have adopted additional methods that supplement the traditional use of morphological characters. These methods include the analysis of courtship 'songs', multivariate analysis of morphological characters, morphometric methods and biochemical techniques.

Henry (1979) investigated courtship and mating in North American examples of *C. plorabunda* and found that rhythmic tremulation of the abdomen occurred in both sexes throughout courtship. These non-audible vibrations are transmitted through the substrate and picked up by receptors in the insects' legs. Further work (e.g. Henry, 1983; 1985a & b; Henry & Wells, 1990; Henry *et al.*, 1993) has revealed the existence of 'song morphs' that are morphologically indistinguishable but produce different courtship songs. In some Nearctic localities these song morphs occur sympatrically but will not naturally interbreed and Henry (1993) has described these as distinct sibling species. However, the significance of song differences in at least some instances remains unclear. Wells (1991) was able to produce fertile hybrids in the laboratory between two North American song-morphs (*C. plorabunda* and *C. johnsoni*) and Duelli (1987) reported that hybridisation did occur in the laboratory between two song morphs in Switzerland. Wells (1991), using gel electrophoresis, has found the genetic distance between three song-morphs of *C. plorabunda* to be no greater than that usually found between individuals of the same animal species. The songs of few European populations have been examined but Henry (1983) has shown that individuals of *C. carnea* from Switzerland produce songs that are radically different from those of otherwise indistinguishable nearctic populations.

Thierry *et al.*, (1992) have adopted a different approach and conducted a multivariate analysis of eight morphological character states in French populations of *C. carnea*. Their results indicate that there are three distinct adult morphs that can be associated with three larval morphs. While refraining from naming these morphs as distinct species, they suggest that these morphs may represent sibling species.

Detailed morphometric studies of the male genitalia by Séméria (1992) have suggested the occurrence of six sibling species of *Chrysoperla carnea* in France.

Electrophoretic and genetic studies of European populations of *C. carnea* have also sug-

gested the presence of sympatric sibling species (Bullini & Cianchi, 1984; Bullini *et al.*, 1983; 1984; Cianchi & Bullini, 1992). Results suggest that certain central European populations are reproductively isolated. However, the values of genetic distance (Nei, 1972) are relatively low so it is postulated that they have recently diverged.

The occurrence of sibling species in the *C. carnea* complex has also been identified following ecological studies. Tauber & Tauber (1977 a; b) identified two sympatric sibling species within Nearctic populations of the *carnea*-complex. One of the sibling species, *C. downesi*, occurs in conifer forests and is dark green all year round. The second sibling species, *C. plorabunda*, occurs in meadows during summer, when it is bright green, but during the winter is found in deciduous woodland and is brown. Morphologically these two taxa are otherwise indistinguishable.

The work described above presents difficulties in interpretation especially when the genus as a whole is being reviewed. First, only a few taxa have been investigated in such ways and then from only a limited geographical range. Also there has been no integration between these techniques. At present none of the so-called song-morphs have been examined using multivariate techniques and few have been investigated using electrophoresis. DNA studies of any of the above sibling species may also produce useful comparative results.

Until *Chrysoperla* populations have been investigated more comprehensively I think that it is unwise to introduce even more names to an already confusing picture. In this work I have decided to recognise species if they can be clearly defined using classic morphological characters, such as those that occur in the male genitalia, or if there is overwhelming evidence from other techniques. This should provide a sound framework on which to base further studies on the possible occurrence of sibling species.

MATERIALS AND METHODS

This work has been based primarily on the extensive collections of *Chrysoperla* specimens held at The Natural History Museum, London, although additional specimens have been kindly loaned by many institutions and individuals around the world. The types of 61 of the 117 described species assignable to *Chrysoperla* have been studied and over 2000 specimens have been

examined and in many cases the genitalia dissected. Drawings were made using a camera lucida attachment on a stereo dissecting microscope or compound microscope. The genitalia were stored in glycerol in glass vials or permanently slide mounted. The type specimens of many species were examined but, where this was not possible, reliably identified specimens were examined instead.

In the synonymic lists provided with each species description only species and subspecies are listed. For several species large numbers of named varieties have also been described. Most of these have not been examined. If this had been attempted the length of time spent on the project would have been considerably increased but almost certainly would have had no impact on the validity of the species-group names used in this study.

There are several morphological characters which were found to be particularly useful when distinguishing species or determining phylogenetic relationships. Some of these involved comparative measurements using a calibrated graticule.

Length of costal setae

The length of the fringe of setae on the costal margin of the fore wing was determined by measuring the height of the fringe at right angles to the costal vein at the level of the second radial crossvein. The more erect the setae, the longer the costal fringe will appear.

Fore wing length: breadth

This ratio is obtained by dividing the overall length of the fore wing by the width at the wing's widest point, measuring perpendicularly from the costa.

Basal dilation of tarsal claw

The relative size of the basal dilation is expressed as a ratio of the claw hook length to the length of the basal dilation of the hind tarsal claw.

ABBREVIATIONS

BAU	Beijing Agricultural University, Beijing, China
BMNH	The Natural History Museum, London, UK
BPBM	Bernice P. Bishop Museum, Honolulu, USA
CAS	California Academy of Sciences, San Fran-

	cisco, USA
CNC	Canadian National Collection, Ottawa, Canada
HU	Hokkaido University, Sapporo, Japan
IP	Institut für Pflanzenschutzforschung, Eberswalde, Germany
IRSM	Institut de Recherche Scientifique de Madagascar
IRSNB	Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Belgium
ITZ	Instituut voor Taxonomische Zoölogie, Amsterdam, The Netherlands
IZAS	Institute of Zoology Academia Sinica, Beijing, China
KU	Kyushu University, Fukuoka, Japan
LACM	Los Angeles County Museum, Los Angeles, USA
LP	La Plata Museum, Buenos Aires, Argentina
MCSN	Museo Civico di Storia Naturale, Genoa, Italy
MCZ	Museum of Comparative Zoology, Cambridge, USA
MNHN	Muséum National d'Histoire Naturelle, Paris, France
MRAC	Musée Royal de l'Afrique Centrale, Tervuren, Belgium
NCI	National Collection of Insects, Pretoria, Republic of South Africa
NHMZ	Natural History Museum of Zimbabwe, Bulawayo, Zimbabwe
NMHU	Museum für Naturkunde der Humboldt-Universität, Berlin, Germany
NMW	Naturhistorisches Museum Wien, Vienna, Austria
NNM	Nationaal Natuurhistorisch Museum, Leiden, The Netherlands
NR	Naturhistoriska Riksmuseet, Stockholm, Sweden
SDNHM	Natural History Museum, San Diego, USA
TM	Transvaal Museum, Pretoria, Republic of South Africa
USP	Museum of Zoology, University of Sao Paulo, Brazil
ZMH	Zoologisches Museum, Hamburg, Germany
ZSBS	Zoologisches Sammlungs des Bayerischen Staates, Munich, Germany
ZSI	Zoological Survey of India, Calcutta, India

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THE SYSTEMATIC POSITION OF *CHRYSOPELRA*

Brooks & Barnard (1990) demonstrated that *Chrysoperla* belonged to the Chrysopini which, with 30 genera, is the largest tribe of Chrysopidae. There are a number of adult characters that may shed light on the phylogenetic relationships of *Chrysoperla*.

In discussing the phylogenetic significance of male genitalic components in Chrysopidae, Brooks & Barnard (1990) concluded that possession of a tignum and gonapsis was autapomorphic for the tribe but plesiomorphic within the Chrysopini. Because of the morphological uniformity of the tignum throughout the tribe, it is unlikely that the tignum has evolved more than once but may have been lost on more than one occasion. An arcuate tignum occurs in six chrysopid genera: *Chrysopidia* (subgenus *Anachrysa*) Hölzel, *Anomalochrysa* McLachlan, *Atlantochrysa* Hölzel, *Chrysoperla* Steinmann, *Dichochrysa* Yang & Yang and *Mallada* Navás. Like *Chrysoperla*, *Chrysopidia* (*Anachrysa*) and *Mallada* (*satilota*-group) do not have a gonapsis but the gonapsis may have been lost independently in these taxa. A gonapsis is present in the other genera mentioned above including the *Mallada desjardinsi*-group.

The yellow median thoracic band is a characteristic feature of most *Chrysoperla* species. Within the family this marking is restricted to the chrysopine genera *Anomalochrysa*, *Apertochrysa* Tjeder, *Chrysoperla*, *Chrysopidia* (subgenus *Chrysotropia*) Navás, *Cunctochrysa* Hölzel, *Dichochrysa*, *Mallada* and *Peyerimhoffina* Lacroix.

Many species of *Chrysoperla* possess dorsal striations on the arcus. This character is probably derived in Chrysopidae since it does not occur elsewhere in the Neuroptera. The occur-

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rence of this character in other chrysopid genera suggests that they are closely related. There are only five other chrysopid genera, and like *Chrysoperla* all are Chrysopini, that have a striated arcesuss: *Apertochrysa*, *Atlantochrysa*, *Dichochrysa*, *Meleoma* and *Suaris* Navás.

Possibly the most frequently used character for distinguishing *Chrysoperla* in keys is the short intramedian cell, the apex of which does not usually reach the first crossvein from the radial sector. This character, although not occurring universally in species of *Chrysoperla*, may be a synapomorphy linking *Chrysoperla* with two other chrysopine genera, *Mallada* and *Peyerimhoffina*. The character does not occur elsewhere in the Chrysopidae.

The sister group to *Chrysoperla* plus the other chrysopine genera discussed above is probably *Dichochrysa*. *Dichochrysa* is linked to these genera by several synapomorphies but also retains some plesiomorphies, particularly in the male genitalia, that have become modified in the other genera. For this reason, *Dichochrysa* will be considered as the outgroup when deciding on character polarities in postulating species relationships within *Chrysoperla*.

SPECIES AFFINITIES WITHIN *CHRYSOPERLA*

There are four distinct species groups within the genus based on the following adult characters.

1. *carnea*-group. This group is the least derived and retains many plesiomorphic chrysopine characters, particularly in the male genitalia. The male genitalia of the group lack spinellae, gonosetae are generally few, the arcesuss is dorsally striated, the entoprocessus are large and crescentic, the gonarcus arch is broad and the lateral plates are large and reniform, and the acumen of the tignum is narrow at its apex. Most of these characters are plesiomorphic for the *Dichochrysa*-group of genera, although the large crescentic entoprocessus are characteristic of the *carnea*-species group and are probably apomorphic. The *carnea*-group can be divided into two sub-groups.

1.1. The first sub-group includes the species *carnea* (Palearctic), *furcifera*, *nipponensis*, *oblita*, *sillemi* (Eastern Palearctic), *iranica* (Middle East), *renoni*, *mediterranea* (Western Palearctic), *zastrowi* (Afrotropics) and *plorabunda*, *adamsi*, *johnsoni* and *downesi* (Nearctic). In these species, with the exception

of *C. oblita*, the basal dilation of the claws is small (apomorphic for this species group).

1.2. The second sub-group comprises *gallagheri* (Eremic) and *annae* (Eastern Palearctic). The numerous gonosetae and small, narrow entoprocessus in the male genitalia are genus-level apomorphies that set this species-subgroup apart.

The following species-groups (2, 3, and 4) all possess numerous gonosetae which is apomorphic within *Chrysoperla*. The possession of a few gonosetae, arranged in a lateral group, is a synapomorph that links most of the genera in the *Dichochrysa* group. Species groups 2 and 3 are linked by the synapomorphic character of broad fore wings and long costal setae.

2. *comans*-group. This group comprises *comans*, *decaryana* (both Afrotropics) and *siamensis* (Thailand). In these species spinellae are absent (plesiomorphic within *Chrysoperla*), but the species share two characters that are apomorphic within the genus: the arcesuss is unstriated dorsally and the entoprocessus are very small. However, this species-group is not well-defined since both these apomorphies occur in other *Chrysoperla* species-groups and, in addition, an unstriated arcesuss is considered to be a secondary character reversal. Nevertheless, the absence of spinellae in the male genitalia of group 2 species preclude their inclusion in groups 3 and 4 since this is autapomorphic for those groups.

3. *nyerina*-group. Species in this group, like group 2, also have broad fore wings and long costal setae, which is apomorphic within *Chrysoperla*. In addition, males possess spinellae on the gonosetae. This character is synapomorphic for groups 3 and 4 and does not occur elsewhere in the Chrysopidae. The *nyerina*-group can be divided into two sub-groups.

3.1. The first sub-group, comprising *nyerina* and *plicata* (both Afrotropics), is characterised by the presence of dorsal striations on the arcesuss (plesiomorphic in *Chrysoperla*) and the possession of simple spinellae. The spinellae show several character states within *Chrysoperla*. *C. plicata* exhibits the simplest condition in which the spinellae arise directly from the gonosaccus. In *nyerina* the spinellae are modified so that each spine is positioned on a small tubercle.

3.2. *C. insulata* (Réunion Island) is the only species in this sub-group. The spinellae are more complex than those found in sub-group 3.1, being formed from 2–3 spines on a small tubercle. This is the only species in the genus which lacks a tignum in the male genitalia. This

structure has probably been secondarily lost.

4. *pudica*-group. This group is characterised by the possession of complex spinellae formed from 5 or more spines on each tubercle. This is the most derived condition of the spinellae within the genus. In this group the fore wings are narrow with short costal setae. The shape and length of the apex of the arcus was found to be particularly useful in distinguishing species of this group. There are two sub-groups.

4.1. This sub-group includes the species *pudica* (Afrotropics), *mutata* and *nigrinervis* (Palearctic). The gonarcus retains its typical broad arch configuration with large, reniform lateral plates and small entoprocessus. The acumen is swollen apically. At present no apomorphic characters have been found to define this sub-group.

4.2. In the second sub-group most species are united by the autapomorphy of a narrow gonarcus arch (which does not occur elsewhere in *Chrysoperla* or in related genera) with narrow lateral plates and minute entoprocessus. However, *dozieri* and *defreitasi* are exceptional in retaining a relatively broad gonarcus arch. Species included are: *exul* (St Helena), *congrua* (Old World tropics), *asoralis*, *exotera*, *externa*, *galapagoensis*, *mexicana* (all Neotropics). These species all possess an apically swollen acumen. However, in the species, *comanche*, *harrisii*, *rufilabris* (all Nearctic), *defreitasi* (Brazil) and *dozieri* (Haiti), the acumen is narrow apically.

Chrysoperla Steinmann

Chrysoperla Steinmann, 1964: 260 [as subgenus of *Chrysopa* Leach]. Type-species: *Chrysoperla carnea* Stephens, 1836, by original designation. [As subgenus of *Anisochrysa* Nakahara by Hölzel, 1970: 51; raised to genus by Séméria, 1977: 238.]

ADULT. Fore wing 9–14 mm. Ground colour pale green, becoming brown in over-wintering specimens. Head sometimes unmarked but usually with red or blackish brown stripe on gena and lateral clypeus. Maxillary palps unmarked or with black dorsal stripe. Labrum indented anteriorly. Mandibles broad, asymmetrical with basal tooth on left mandible. Head width : eye width = 1.8–2.6 : 1. Antenna usually shorter than fore wing; flagellar segments 2–3 times as long as broad; setae arranged in four rings. Pro-, meso- and metanotum usually with yellow or white longitudinal median band, sometimes marked with lateral red spots; dorsal setae long and pale or short and dark. Leg unmarked; claw with, or

occasionally without, basal dilation. Fore wing unmarked; narrow or broad (length : breadth = 2.6–4.1 : 1); venation green or with gradate crossveins black; costal setae short, inclined towards wing apex or sometimes long, erect; basal costal crossveins sinuous; stigma unmarked; cell *im* narrow, ovate; 1st Rs cross-vein usually meeting *Psm* distad of apex of *im*, but sometimes meets *im* at apex or subapically; gradates in two parallel series, basal inner gradate meets *Psm*. Abdomen usually with longitudinal median yellow or white stripe.

GENITALIA♂. Apex of sternite 8+9 with distinct lip beset with short setae. Ectoproct with invagination ventrad of callus cercus. Gonosaccus with gonosetae, with or without spinellae. Arcus narrow with or without dorsal striations. Entoprocessus crescentic, large or minute. Gonarcus broadly arcuate with reniform lateral plates or arch narrow with narrow lateral plates. Tignum arcuate; acumen long and narrow or short, swollen. Gonapsis absent.

GENITALIA♀. Praegenitale absent. Subgenitale bilobed apically, tapering and extended basally. Spermatheca narrow; ventral impression slight; vela short; duct short.

LARVA. Abdomen narrow, fusiform, not humped. Thoracic and abdominal tubercles small, spherical; setae short, smooth, not hooked apically; transverse row of metanotal setae absent; latero-dorsal chalazae present but indistinct, bearing single seta. Debris not carried.

REMARKS. Adult males of *Chrysoperla* are characterised by the autapomorphic possession of a lip at the apex of sternite 8+9. The fusiform larvae with small tubercles and non-debris carrying habit are also distinctive. These characters are apomorphic at the genus-level. Other autapomorphies, but which are not shared by all species in the genus, include: the presence of spinellae and an over-wintering diapause occurring in the adult stage.

As a result of this study it is now apparent that, in order to maintain *Chrysoperla* as a monophyletic group, a few species listed under *Chrysoperla* by Brooks & Barnard (1990) should be moved to different genera. The confusion has arisen because the possession of a tignum but lack of a gonapsis was previously considered apomorphic for *Chrysoperla*. However, it is now clear that the gonapsis has been lost independently at least twice in the Chrysopidae. Consequently, the species *anpingensis* Esben-Petersen, *australis* New, *krakatauensis* Tsukaguchi, *maquilingi*

Banks, *meloui* Navás, *satilota* Banks, *suzukii* Okamoto and *triactinata* New, in which sternite 8+9 is not lipped in males, must be reassigned (summarised in checklist, p.173).

Yang & Yang (1990b) proposed that the *Mallada boninensis* (Okamoto) (now a synonym of *M. desjardinsi* Navás (Hölzel & Ohm, 1992)) -group of species (Brooks & Barnard, 1990) be considered as a distinct genus and that the remaining *Mallada* species be included in a new genus, *Dichochrysa* Yang & Yang. This proposal has merit since there are several autapomorphies that define *Mallada* s. str., and *Mallada* s.l. seems to be paraphyletic.

The males of *Mallada* s. str. are characterised by narrow ectoprocts, subapical lobe on sternite 8+9, two pairs of gonosetae in the genitalia and in the fore wing by the basal inner gradate meeting *Psm*. Species in the *desjardinsi*-group possess a tignum with a minute acumen, a broad arcessus and a cruciform, basally expanded gonapsis. The following species are transferred to *Mallada* and are members of the *desjardinsi*-group: *anpingensis* Esben-Petersen comb. n., *meloui* Navás comb. n. and *maquilingi* Banks (= *inconspicua* Navás) comb. n. In a second species group within *Mallada* s. str. the gonapsis is absent (instead there is a large V-shaped apodeme at the apex of sternite 8+9), the gonosetae are simple (in the *desjardinsi*-group the setal bases are thickened so that they resemble mounted needles), the arcessus is narrow and elongate and the acumen is short and ovate. It is now clear that some species formerly included in *Chrysoperla* belong to this second species-group and so are reassigned to *Mallada*: *krakatauensis* Tsukaguchi comb. n., *satilota* Banks comb. n. and *suzukii* Okamoto comb. n.

The presence of gonocristae in *australis* and *triactinata* suggest a relationship with *Apertochrysa*, although species of this genus lack a tignum and possess a gonapsis. It may be necessary to erect a new genus for these two Australian species but for the present they are provisionally assigned to *Apertochrysa*: *Apertochrysa australis* comb. n., *Apertochrysa triactinata* comb. n.

I have been unable to examine the types of the following species that are deposited in BAU or IZAS, China: *Chrysoperla quinlingensis* Yang & Yang, *C. thelephora* Yang & Yang, *C. yulinica* Yang & Yang (Yang & Yang 1989), *C. bellatula* Yang & Yang, *C. hainanica* Yang & Yang, *C. longicaudata* Yang & Yang, *C. sola* Yang & Yang (Yang & Yang, 1992) or *Chrysopa xizangana* Yang (Yang, 1988). Unfortunately, it is not possible to decide the affinities of these species

from the original descriptions so at present they must remain *incertae sedis*.

DISTRIBUTION. Eight species are known from the Afrotropics, six from the Western Palaearctic region, three from the Eastern Palaearctic, there is one Palaearctic species, three Oriental species, one species occurs throughout the Old World tropics, there are ten Nearctic species and four Neotropical species.

Key to the world *Chrysoperla* species

This key does not include the following Chinese species which were unavailable for examination: *Chrysoperla quinlingensis* Yang & Yang, *C. thelephora* Yang & Yang, *C. yulinica* Yang & Yang, *C. bellatula* Yang & Yang, *C. hainanica* Yang & Yang, *C. longicaudata* Yang & Yang, *C. sola* Yang & Yang or *Chrysopa xizangana* Yang.

- 1 Gradates green 2
- Gradates black or greyish 17
- 2 Base of claw undilated or only slightly swollen (Figs 33, 51) 3
- Base of claw with distinct step-like dilation, at least one-quarter length of claw hook (Fig. 5) 8
- 3 Head with extensive black/brown markings, with X-mark between antennae *furcifera* Okamoto
- Markings on head restricted to red or brown stripe on gena, frons or clypeus 4
- 4 Antennae black/brown; veins 1A and 2A of fore wing black/brown *mexicana* sp. n.
- Antennae green; veins 1A and 2A of fore wing green 5
- 5 Intramedian cell (*im*) long, apex of *im* meets first *Rs* crossvein (Fig. 32) 6
- Intramedian cell short, apex of *im* not reaching first *Rs* crossvein (Fig. 1) 7
- 6 Post-ocular region marked red; gena marked with red spot; apex of fore wing pointed; ♂ genitalia with spinellae *harrisii* Fitch
- Post-ocular region unmarked; gena marked with brown spot; apex of fore wing rounded; spinellae absent in ♂ genitalia *annae* sp. n.
- 7 Costal setae long, 1.5 mm; wing apex rounded (Fig. 68); claw hook very long (Fig. 69) . *renoni* Lacroix
- Costal setae short, *mediterranea* Hölzel
- 8 Basal dilation of claw large, at least half length of claw hook
- Basal dilation of claw small, distinctly less than half length of claw hook 10

- 9 Pronotum marked with brown spot in each corner in addition to yellow median band; vertex marked with red lateral spot *exul* McLachlan
- Pronotal markings restricted to yellow median band; vertex unmarked *comanche* Banks
- 10 Gena usually marked with red spot; red post-ocular spot usually present; ♂: spinellae present 11
- Gena usually marked with brownish/black spot, which may be overlaid with red; post-ocular region usually unmarked; ♂: spinellae absent 12
- 11 Basal dilation of claw less than third length of claw hook (Fig. 189); Old World tropics ♂: neck of acumen of tignum short, swollen apically *congrua* Walker
- Basal dilation of claw about third length of claw hook (Fig. 228); Neotropics; ♂: neck of acumen long, swollen apically *externa* Hagen
- 12 Fore wing long, more than 13 mm; ♂: 10–20 gonosetae lateral group *annae* sp. n.
- Fore wing shorter, usually less than 13 mm; ♂: few gonosetae (less than 10 in lateral group) 13
- 13 Fore wing rounded, symmetrical apically (Fig. 40); ♂: membranous lip of sternite 8+9 narrow, elongate (Fig. 42) *iranica* Hölzel
- Fore wing tapered, asymmetrical apically (Fig. 3) (in some northern European specimens fore wing may be rounded with long setae Fig. 2); ♂: membranous lip of sternite 8+9 short, broad, rounded (Fig. 8) 14
- 14 Basal dilation of claw one-quarter or less length of claw hook (Fig. 25) 15
- Basal dilation of claw more than third length of claw hook 16
- 15 First *Rs* crossvein at oblique angle to *Rs*; Afrotropics *zastrowi* Esben-Petersen
- First *Rs* crossvein usually at right angles to *Rs*; India *sillemi* Esben-Petersen
- First *Rs* crossvein variable; Nearctic *downesi* Smith
- 16 Palaearctic *carnea* Stephens
- Nearctic *plorabunda* Fitch species group
- 17 Gena marked with red spot or stripe; if unmarked, clypeus with black spot [some specimens of the *plorabunda* species-group complex may key out at this point] 18
- Gena marked brown/black, often with red overlay; if unmarked, clypeus with red spot 30
- 18 Costal setae of fore wing long, at least 1 mm, often erect 19
- Costal setae short, inclined towards wing apex . 23
- 19 ♂: spinella present 20
- ♂: spinella absent 21
- 20 Gena marked with red spot, clypeus unmarked; pronotum marked with red stripe in each corner and red medio-lateral spot; claw rounded posteriorly, with very large basal dilation (Fig. 134); fore wing less than 13 mm; ♂: apex of sternite 8+9 narrow, prominent (Fig. 135); acumen of tignum short, swollen apically (Fig. 136) ... *plicata* Tjeder
- Gena and clypeus marked with red stripe; any red spots on pronotum restricted to anterior corner; claw straight posteriorly with smaller basal dilation (Fig. 125); fore wing more than 13 mm; ♂: apex of sternite 8+9 short and broad (Fig. 126); acumen long, narrow apically (Fig. 127) *nyerina* Navás
- 21 ♂: arecessus striated dorsally (Fig. 79) *oblita* Hölzel
- ♂: arecessus without dorsal striations 22
- 22 Fore wing less than 12 mm; ♂: arecessus narrow (Fig. 104); acumen of tignum short, swollen (Fig. 105); apex of sternite 8+9 prominent, longer than membranous lip (Fig. 101) *comans* Tjeder
- Fore wing more than 12 mm; ♂: arecessus broad (Fig. 113); acumen long, parallel-sided (Fig. 112); sternite 8+9 not elongated apically (Fig. 111) *decaryana* Navás
- 23 Maxillary palps with black dorsal stripe 24
- Maxillary palps unmarked 27
- 24 Red post-ocular spot present 26
- Post-ocular region unmarked 25
- 25 ♂: apical membrane of arecessus narrow, elongate (Fig. 281); acumen of tignum short, broad, swollen apically (Fig. 280) *rufilabris* Burmeister
- ♂: apical membrane of arecessus short, broad, tapered at apex (Fig. 216); acumen long, swollen apically (Fig. 215) *asoralis* Banks
- 26 Front of vertex marked with two narrow red spots; ♂: arecessus abruptly widened at apex; gonarcus arch broad (Fig. 202) *dozieri* Smith
- Front of vertex unmarked, but Cuban specimens may have a pair of broad red spots; ♂: arecessus narrow apically; gonarcus arch narrow (Fig. 221) *exotera* Navás
- Front of vertex unmarked; ♂: arecessus broad, narrowed subapically, spatulate at apex (Fig. 206) *defreitasi* sp. n.
- 27 Basal dilation of claw less than half length of claw hook 28
- Basal dilation of claw more than half length of claw hook 29
- 28 Basal dilation of claw about one-quarter length of

- claw hook; scape with red stripe ♂: spinellae absent *gallagheri* Hölzel
- Basal dilation of claw distinctly less than one-quarter length of claw hook; scape unmarked; ♂: spinellae present *nigrinervis* sp. n.
- 29 Basal dilation of claw less than two-thirds length of claw hook *mutata* McLachlan
- Basal dilation of claw hook about two-thirds length of claw hook *pudica* Navás
- 30 Gena unmarked; intramedian cell (*im*) long, extends beyond first *Rs* crossvein (Fig. 115) 31
- Gena marked with brown spot; *im* short, at most *Rs* crossvein meets apex of *im* (Fig. 90) 32
- 31 Palps marked with black dorsal stripe; black lateral stripe on clypeus; post-ocular region unmarked; ♂: tignum absent; spinellae present ... *insulata* Fraser
- Palps unmarked; red spot on clypeus; red post-ocular spot present; ♂: tignum present; spinellae absent *siamensis* sp. n.
- 32 Basal dilation of claw less than half length of claw hook (Fig. 238); crossveins in basal half of fore wing of fore wing entirely black/brown; pronotum with narrow black median stripe; ♂: spinellae present *galapagoensis* Banks
- Basal dilation about half as long as claw hook; crossveins in basal half of fore wing black/brown at each end, middle section green; pronotum with yellow median band; ♂: spinellae absent 33
- 33 USA *johnsoni* Henry, Wells & Pupedis
- Eastern Palaearctic *nipponensis* Okamoto

SPECIES DESCRIPTIONS

Chrysoperla carnea (Stephens)

(Figs 1–4, 6–13, 17, 19–20)

Chrysoperla carnea Stephens, 1836: 103. Lectotype ♀; ENGLAND: near London (BMNH) [examined]. [Lectotype designated by Leraut, 1991: 78.]

Chrysoperla affinis Stephens, 1836: 104. Lectotype ♀, ENGLAND: near London (BMNH) [Lectotype designation by Leraut, 1991: 78.] [examined]. [Synonymized by Schneider, 1851: 68.]

Chrysoperla microcephala Brauer, 1850: 6. Holotype, AUSTRIA: Vienna (NMW) [not examined]. [Synonymized by Navás, 1908: 13.]

Chrysoperla vulgaris Schneider, 1851: 68. Syntypes, Europe [not traced]. [Synonymized by Killington, 1931: 112.]

Chrysoperla lamproptera Stein, 1863: 419. Syntypes, YUGOSLAVIA: Dalmatia, Casteln-uovo (*Kruper*) (NMHU) [not examined]. [Synonymized by Aspöck *et al.*, 1980: 268.]

Chrysoperla lucasina Lacroix, 1912: 203. Lectotype ♂, ALGERIA: Frenda, 1911 (Lucas) (MNHN) [Lectotype designated by Leraut, 1991: 78.] [examined]. [Synonymized with *carnea* Stephens by Aspöck *et al.*, 1980: 268; reinstated as valid species by Leraut, 1991: 76.] **Syn. n.**

Cintameva angelnina Navás, 1931a: 84. Holotype, GERMANY: Satrup (Angeln), Anfang. ix.1930 (*Lichtwerk*) (ZMH) [type destroyed]. [Nomen dubium; synonymised by Aspöck *et al.*, 1980: 410.]

Chrysoperla ferganica Navás, 1933b: 107. Syntypes, USSR: Turkestan, Fergana, Sphara, 25.vii.1928 (NMHU) [not examined]. [Synonymized by Aspöck *et al.*, 1980: 268.]

Chrysoperla pictavica Lacroix, 1933: 147. Lectotype ♂; FRANCE: Deux-Sèvres, marais d'Amuré, 27.vi.1921 (*Lacroix*) (MNHN) [Lectotype designated by Leraut, 1982: 48.] [examined]. [Synonymized by Aspöck *et al.*, 1980: 268.]

Chrysoperla carnea var. *adaptata* Navás, 1934a: 1. Holotype, CHINA: Jiangsu Prov., Hufu (Loubou), 3.viii.1933 (IZAS) [not examined]. [As subspecies of *nipponensis* (Okamoto) Yang & Yang, 1990a: 79.] **Syn. n.**

Chrysoperla lundbladi Tjeder, 1939: 8. Holotype ♂, MADEIRA: Caramujo, 1250m (*Lundblad*) (NRS) [not examined]. [Synonymized by Aspöck *et al.*, 1980: 268.]

Chrysoperla maderensis Tjeder, 1939: 9. Holotype ♂, MADEIRA: Rabacal, 1080m, 17.vii–4.viii.1935 (*Lundblad*) (NR) [not examined]. [Synonymized with *carnea* Stephens by Aspöck *et al.*, 1980: 268; synonymized with *lucasina* Lacroix by Leraut, 1991: 78.] **Syn. n.**

Chrysoperla canariensis Tjeder, 1939: 31. Holotype ♂, CANARY IS: Gran Canary, Tafira (*Frey*) (NRS) [not examined]. [Synonymized by Aspöck *et al.*, 1980: 268.]

Chrysoperla shansiensis Kuwayama, 1962: 9. Holotype ♀, CHINA: Shansi, Wangmaochen, 14.v.1942 (*Yasumatsu*) (KU) [examined]. **Syn. n.**

Chrysoperla (Chrysoperla) carnea Stephens; Steinmann, 1964: 260.

Chrysoperla (Chrysoperla) canariensis Tjeder; Tjeder, 1966: 391.

Chrysoperla (Chrysoperla) lundbladi Tjeder; Tjeder, 1966: 391.

Anisochrysa (Chrysoperla) carnea (Stephens); Hölzel, 1970: 51.

Chrysoperla carnea (Stephens); Canard & Lau-deho, 1978:71.

Chrysopa carnea nanceiensis Séméria, 1980: 29. Syntypes, FRANCE: Nancy (Poivre) (NANCY UNIV.) [not examined]. [Synonymized by Leraut, 1991: 80; reinstated as valid species by Séméria, 1992: 337.] **Syn. n.**

Chrysoperla shansiensis (Kuwayama); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 1) ♂, 9–13 mm; ♀, 11–14 mm. Head marked with brown/black stripe on gena and lateral clypeus, often overlaid with red stripe; post-ocular spot absent. Maxillary palps unmarked or with black stripe dorsally. Antennae shorter than fore wing. Pronotum marked with yellow/white longitudinal median stripe, greyish spot sometimes present in anterior corner; prothoracic setae short, dark or sometimes pale. Claw (Fig. 4) with small basal dilation, about one-third length of claw hook (2.86–3.0: 1; mean 2.70). Fore wing variable in width (length: breadth = 2.7–3.1: 1); pointed or rounded apically; venation green but costal and Rs crossveins often with black spot at Sc and R respectively and crossveins *im-Psm*, *cl-c2*, *Rs-im* sometimes entirely black; costal setae short or relatively long (0.4–1.6 mm), inclined towards wing apex; cell *im* short, not reaching 1st *Rs* crossvein or sometimes meeting at apex; 1st *Rs* crossvein meets *Rs* obliquely or at 90°; 4–7 inner gradates, 5–8 outer gradates.

GENITALIA♂ (Figs 8–10). Lip of sternite 8+9 broad, rounded. Apodeme of tergite 9 long, extending well-beyond callus cercus; callus cercus broad, ovate; 23–33 trichobothria. Spinellae absent. Gonosetae few, 4–6 in lateral clump, often asymmetrical in number. Arcessus striated dorsally; tip blunt; apex straight or curved ventrally at 45–90°. Entoprocessus large, crescentic. Gonarcus with large, reniform lateral plates; arch broad. Acumen of tignum long, rounded, not swollen, apically.

GENITALIA♀ (Figs 11–13). Callus cercus ovate; 37 trichobothria. Subgenitale with short basal extension. Spermatheca with deep ventral impression; vela long; duct long.

REMARKS. The male genitalia of *carnea* are practically indistinguishable from *zastrowi*, *mediterranea*, *furcifera*, *oblita*, *nipponensis* and *plorabunda* and these species are obviously closely related to each other. However, *carnea* can usually be differentiated from these species by the combination of green gradate crossveins and relatively broad wings, small basal dilation of

the claws and short, black prothoracic setae.

Chrysopa shansiensis Kuwayama is treated as a synonym of *carnea* for the first time in this work. Unfortunately, all that remains of the holotype of *shansiensis* is the extreme apex of the abdomen (sternite 8, the ectoprocts and spermatheca) and from this it is impossible to be certain of the true identity of the species. In his description of *shansiensis*, Kuwayama (1962) compares the species with *Nineta flava* (Scopoli) and *N. vittata* (Wesmael). However, the wing venation shown in the photograph of the complete holotype of *shansiensis* (Kuwayama, 1962) does not resemble species of *Nineta*. Rather, the specimen appears to be a *Chrysoperla* species and the description suggests that it is a weakly marked example of *carnea*.

Yang & Yang (1990a) considered *C. carnea* var. *adaptata* Navás to be a subspecies of *nipponensis*. They based their decision on similarities in the female genitalia between *nipponensis* and *adaptata* without indicating what those similarities were. I have found the female genitalia of *nipponensis* and *carnea* to be indistinguishable. One character that readily serves to distinguish *carnea* and *nipponensis*, however, is that the gradate crossveins are green in *carnea* but black in *nipponensis*. The gradates of *adaptata* are green so it seems logical to treat this taxon as a synonym of *carnea*.

GEOGRAPHICAL VARIATION. *Mediterranean.* A series of specimens examined from Crete, Sardinia, central Greece (Amfissa, Fokidhos), the Peloponnese and Spain have distinctive markings. The most striking features, which distinguish this population from typical *carnea*, are the very pale green overall ground colour of the body and a pair of conspicuous black dorso-lateral spots on the basal segments of the abdomen. In addition, the head lacks any red markings and the longitudinal median stripe on the pronotum and abdomen is white. All crossveins are black at each end, rather than being entirely green, the wings may be pointed or rounded apically with short or long costal setae respectively. The basal dilation of the claw is larger than typical for *carnea* (Fig. 6), being only slightly under half the length of the claw hook (2.06–2.64: 1; mean 2.42).

Israel. A single male specimen from Lake Huleh on the River Jordan was examined that differed in several respects from typical *carnea*, although the genitalia were indistinguishable from typical *carnea*. Head suffused entirely red; gena marked with a faint brown stripe; claw with large basal dilation (Fig. 7) (2.41: 1); costal setae

long, semi-erect; fore wing apex rounded. However, the lack of further material precludes the description of this specimen as a distinct taxon.

Europe. Leraut (1991; 1992) drew attention to the co-occurrence of three forms of *carnea* in Europe. The first, which Leraut established as *carnea* s.str., has a dark brown to black stripe on the gena, rounded apex to the fore wing (Fig. 2) and relatively long wing setae. This form is dominant in northern European populations but occurs throughout the distributional range. A second form was referred to as *carnea* B (Leraut, 1991) but was later elevated to species, and identified as *C. kolthoffi* (Navàs) (Leraut, 1992). This taxon was said to differ from *carnea* s. str. in having short, dark setae on the wing veins and narrow arms in the tignum of the male genitalia. However, I was unable to detect any difference between specimens identified by Leraut as *kolthoffi* and those identified as *carnea*. The narrow arms of the tignum shown by Leraut (1991) could be due to individual variation or distortion, as is often the case in teneral or immature specimens. In any case, *C. kolthoffi* is an incorrect name for this taxon since *kolthoffi* is a synonym of the Eastern Palearctic species, *Chrysoperla nipponensis* (Okamoto). The third form, which Leraut (1991) referred to as *C. lucasina* (Lacroix), differs from *C. carnea* in having a paler stripe on the gena, short costal setae and a straighter apico-posterior margin in the fore wing which makes the wing appear more pointed (Fig. 3). This form is dominant in southern Europe, north Africa and the Middle East.

However, the morphological differences indicated by Leraut are not as clear-cut as he suggests. First, I have found every stage of genal marking from red to dark brown on specimens that would otherwise be referable to *lucasina* and, conversely, *carnea*-type specimens with a pale brown stripe on the gena. Secondly, I have examined several different contemporaneous and sympatric series from various European localities that show a gradation from the pointed wing form with short setae to the rounded wing form with long setae. Other specimens were examined in which the fore wing was rounded but costal setae short and, conversely, specimens in which the fore wing was pointed apically and the costal setae long. In addition, I examined several specimens that exhibited an intermediate condition and it was not possible to decide whether the wings were pointed or rounded apically.

In North America there is similar variation in specimens of *C. plorabunda* with some specimens having rounded wing apices with long cos-

tal setae but the majority having more pointed wings and short costal setae. No distinction has yet been found in the courtship songs of round wing and pointed wing forms of *C. plorabunda*.

No significant difference was found in the size of the basal dilation of the claw in specimens referable to f. *typica* or f. *lucasina*.

At present, I do not consider the morphological evidence conclusive enough to treat *C. lucasina* and *C. carnea* as distinct species. However, further taxonomic and biological investigations will help to clarify this problem.

As an interesting addition to these considerations, Barnard *et al.* (1986) reported the sympatric occurrence of two forms of *carnea* larvae, which had different head markings, on oak trees in southeast England. However, although a long series of adults was also collected throughout the same year they were all f. *typica* with rounded wing apices and long wing setae.

Using a multivariate statistical method Thierry *et al.* (1992) discriminated three morphs of *carnea* in populations in central France which they referred to as *carnea*, *lucasina* and *kolthoffi*. The three main variables used to produce their results were the colour and length of the costal setae on the fore wing, the colour and distribution of prothoracic setae, and the shape of the spot on the stipe. These interesting results point the way to further research that may establish the presence of sibling species among populations of *carnea* but at present it is premature to recognise these taxa as valid species. It is beyond the scope of this study to conduct extensive multivariate analysis of *Chrysoperla* species.

Séméria (1992) carried out a morphometric analysis of the male genitalia of some French specimens in the *carnea* species group. Essentially he examined the size of the lateral plates of the gonarcus. This was done by measuring the angles between lines drawn from the apex of the arcessus to the apex of the lateral plates (BAC) and the angle between lines from the apex of the lateral plates to the mid-point of line drawn along the base of the lateral plates (BDC). Séméria considered that the results indicated the presence of six distinct species (*C. renoni*, *lucasina*, *mediterranea*, *carnea*, *nanciensis* and *carnea* sp. B) in France. However, I carried out a similar analysis of *carnea* group specimens and produced results that differed widely from those of Séméria (1992).

Because Séméria does not record any variation in the angles he measured I assume that the results he obtained for each taxon were derived from only one specimen. My results show considerable variation between specimens and overlap

the range measurements given by Séméria for all the taxa he investigated. I consider it highly unlikely that each one of the specimens I examined is a distinct species in its own right and is also different to the taxa investigated by Séméria. While the technique advocated by Séméria is worthy of further investigation it is desirable that a large number of specimens are examined before any taxonomic decisions can be based on the results. Consideration should also be given to factors that may affect the results such as the effects of compressing the genitalia on a microscope slide. The maturity of the specimen may also effect the results. Adams & Penny (1987) have suggested that the genitalia may become more heavily sclerotised as the insect matures. This implies that the lateral plates of the gonarcus may actually increase in size as an individual ages.

The morphology of the tignum shows considerable variation throughout the range of *C. carnea* (Figs 17–20) both in length of the arms and length of the acumen. Although I could not detect any obvious pattern in this variation this may merit further investigation.

Henry (1985a) reports the occurrence of two distinct song morphs of *carnea* in Europe. One, 'Basel *carnea*', from lowland meadows and oak scrub in France, Switzerland and south to Morocco. A second morph, 'Ticino *carnea*', occurs in the southern Swiss Alps. These taxa cannot be distinguished from one another morphologically.

DISTRIBUTION. Palaearctic.

MATERIAL EXAMINED (429♂, 695♀) Europe: Belgium, Corsica, Crete, Cyprus, Czechoslovakia, Denmark, France, Germany, Italy, Norway, Switzerland, Portugal, Sardinia, Spain, UK, Yugoslavia; North Africa: Algeria, Canary Is, Egypt, Libya, Madeira, Tunisia; Middle East: Iran, Iraq, Jordan, Saudi Arabia, Turkestan, Turkey, Yemen; India (Kashmir); China.

Ohm & Hölzel (1992) record *C. carnea* from Sudan and Senegal but all specimens examined in this study from the Sahel region of Africa were referable to *C. zastrowi*.

Chrysoperla sillemi (Esben-Petersen) **stat. rev.**

(Figs 5, 8)

Chrysopa sillemi Esben-Petersen, 1935: 234. Holotype ♀, INDIA: Kashmir, Karakorum, Maralbashi, 110m, 20.iii.1930 (*Sillem*) (ITZ) [examined]. **Stat. rev.**

Chrysopa (Chrysoperla) gujaratensis Ghosh, 1976a: 74. Holotype ♂, INDIA: Gujarat, Dwarka, E. of Rly Stn, 2.xi.1973 (*Gupta*) (ZSI) [not examined]. **Syn. n.**

Chrysopa (Chrysoperla) punensis Ghosh, 1976b: 189. Holotype ♂, INDIA: Maharashtra, Khed, R. Bhama, Pune, 3.vii.1976 (*Ghosh*) (ZSI) [not examined, paratype examined]. **Syn. n.**

Chrysopa (Chrysoperla) sanandensis Ghosh, 1977: 103. Holotype ♂, INDIA: Gujarat, Dadagram, Sanand, 8.xii.1973 (*Cherian*) (ZSI) [not examined, paratype examined]. **Syn. n.**

Fore wing ♂, 10–13 mm; ♀, 11–14 mm. Head occasionally unmarked or with pale brown stripe on gena and clypeus, overlaid with red stripe. Maxillary palps brown dorsally. Antennae shorter than fore wing. Pronotum with yellow or white median stripe; setae short (0.6 mm), dark or pale. Claw (Fig. 5) with small basal dilation 3.60–5.13: 1 (mean 4.17). Fore wing length; breadth = 2.7–3.3: 1; venation green; apex pointed; costal setae short, inclined towards wing apex.

GENITALIA ♂ and ♀ as for *C. carnea* except in male genitalia, acumen of tignum short (Fig. 8).

REMARKS. *C. sillemi* can be reliably distinguished from *C. carnea* only by differences in the size of the basal dilation of the claw. In *C. sillemi* the basal dilation is about one quarter the length of the claw tooth but in *C. carnea* the basal dilation is at least one third the length of the claw tooth.

Because the ZSI has a policy of not lending holotypes I was unable to borrow the types of the *Chrysoperla* species described by Ghosh. However, paratypes were available for *C. punensis* and *sanandensis*. These specimens were typical examples of *C. sillemi*. Unfortunately, no paratypes were available for *C. gujaratensis*. Nevertheless, from the good description and figures provided for this species (Ghosh, 1976a) there can be little doubt that it is synonymous with *C. sillemi*. The setae shown on the tignum probably originate from the subanale.

DISTRIBUTION. India, Pakistan. Specimens of both *C. sillemi* and *C. carnea* were examined from Kashmir.

MATERIAL EXAMINED (23♂, 30♀) India, Pakistan.

Chrysoperla plorabunda (Fitch)

(Figs 15, 21–22)

Chrysopa plorabunda Fitch, 1855: 792. Syntypes, USA: New York State & Illinois (MCZ) [not examined]. [Synonymized with *carnea* Stephens by Banks, 1903: 155; reinstated as valid species by Henry, 1983: 299.]

Chrysopa robertsonii Fitch, 1855: 792. Syntypes, USA: Arkansas, Tullehassie (MCZ) [not examined]. [Synonymized by Banks, 1903: 162.]

Chrysopa pseudographa Fitch, 1855: 793. Syntypes, USA: Illinois (MCZ) [not examined]. [Synonymized by Banks, 1903: 162.]

Chrysopa illinoiensis Shimer, 1865: 208. USA: Illinois [not examined]. [Synonymized by Banks, 1903: 155.]

Chrysopa californica Coquillett, 1890: 288. Holotype, USA [holotype not traced]. [Smith, 1932: 594 as synonym of *plorabunda*; Adams, 1956: 45 as subspecies of *plorabunda*.] **Syn. n.**

REMARKS. Morphologically *Chrysoperla plorabunda* is indistinguishable from *C. carnea*. However, Henry (1983; 1985a; 1985b and *in litt.*) has provided evidence that these two taxa should be regarded as distinct species. The substrate-borne songs of European populations of *carnea* are completely different from those of eastern and western New World populations of *plorabunda*. Egg production resulting from crosses of the Old and New World populations of these two taxa was very low. Although Henry's data is derived from relatively few populations it is persuasive and I am reluctant to synonymise the species solely on morphological grounds. The accrual of more song data from European and American populations will clarify the issue.

Like *carnea*, specimens of *plorabunda* varied in the length of the arms and acumen of the tignum. In addition, the number of gonosetae varied from four to eight in each lateral group. This is a greater range of variation than that noted in *carnea*. The basal dilation of the claw of *C. plorabunda* is similar in size to that of *C. carnea* (2.4–3.09: 1; mean 2.83)

DISTRIBUTION. Nearctic.

MATERIAL EXAMINED (22♂, 38♀) Canada, Mexico, USA (Arizona, California, N. & S. Carolina, Colorado, Florida, Montana, Nebraska, Oregon, Texas, Utah, Vermont, Washington, Wisconsin).

Chrysoperla johnsoni Henry, Wells & Papedis

(Fig 23)

Chrysoperla johnsoni Henry *et al.*, 1993: 10. Holotype ♂, USA: Oregon, Philomath (Mary's Peak), 28.ix.1989 (Henry & Wells) [not examined].

Fore wing ♂, 10–11.5 mm; ♀, 11–13.5 mm. Head marked with red stripe on gena, sometimes with additional brown stripe; red lateral stripe on frons and clypeus; red post-ocular spot present or absent. Maxillary palps marked brown dorsally. Antenna shorter than fore wing. Pronotum with yellow median longitudinal band and greyish lateral stripe, sometimes with reddish brown mid-lateral spot; prothoracic setae short, pale or dark. Claw (Fig. 15) with large basal dilation, about half length of claw hook (2.10–2.82: 1; mean 2.34). Fore wing narrow or broad (length : breadth = 2.9–3.4 : 1), rounded apically; costal setae short (0.6–0.8 mm), inclined towards wing apex; 1st Rs crossvein meets Rs obliquely; cell *in* short, not meeting 1st Rs crossvein; 4–6 inner gradates, 5–7 outer gradates; gradates green or black; crossveins green or black at each end (including at wing margins); R marked with short black stripe basal of tympanal organ. Abdomen unmarked or marked with brown dorso-lateral spot on segment two.

GENITALIA ♂ and ♀ indistinguishable from *Chrysoperla carnea*.

REMARKS *Chrysoperla johnsoni* was distinguished from *C. adamsi* and *C. plorabunda* on the basis of differences in their courtship songs (Henry *et al.*, 1993; Henry, 1993). There are two morphs of *C. johnsoni*. The typical form, which is indistinguishable morphologically from *C. plorabunda*, has green gradates and the basal dilation of the claw is about 2.8:1. The second form, at present known only from the San Francisco Bay area, has black gradate crossveins, the basal dilation of the claw is usually broad (about 2.2:1), the head has extensive red markings and the gena often lacks a brown stripe. This form is morphologically indistinguishable from the 'mohave' morph of *C. downesi*.

DISTRIBUTION. Western USA

MATERIAL EXAMINED (7♂, 15♀) USA: Arizona, California.

***Chrysoperla adamsi* Henry, Wells & Papedis**

Chrysoperla adamsi Henry *et al.*, 1993: 9. Holotype, ♂, USA: Oregon, Philomath (Mary's Peak), 28.ix.1989 (Henry & Wells) [not examined].

Fore wing 12–13 mm. Head marked with reddish brown spot on gena; red stripe on gena, lateral frons, lateral clypeus. Maxillary palps marked black dorsally. Pronotum and vertex of head with yellowish white median stripe; setae short, black. Basal dilation of claws less than half length of claw hook (2.54: 1). Wing venation green; fore wing relatively narrow (length: breadth = 2.9–3.2: 1); apcx pointed; costal setae short (0.4–0.6 mm), inclined towards wing apex; *im* short, not reaching 1st *Rs* crossvein; 6 inner gradates, 6–7 outer gradates.

GENITALIA ♂, ♀ as described for *C. carnea*.

REMARKS. *C. adamsi* cannot be separated morphologically from *C. plorabunda*, *C. johnsoni* or *C. downesi*. However, Henry *et al.* (1993) has distinguished this taxon on the basis of its courtship song. Unlike *C. johnsoni*, which may have black gradate crossveins, specimens of *C. adamsi* have green wing venation.

DISTRIBUTION. Western USA

MATERIAL EXAMINED (1♂, 1♀) USA: California [material identified by C.S. Henry].

***Chrysoperla downesi* (Smith) stat. rev.**

(Figs 14, 16)

Chrysopa downesi Smith, 1932: 594. Holotype ♀ CANADA: British Columbia, Kelowna (CNC) [not examined]. [Synonymized with *carnea* Stephens by Garland, 1985a: 93.] **Stat. rev.**

Chrysopa mohave Banks, 1938: 120. Holotype, USA (MCZ)[not available for examination]. [Synonymized with *C. carnea* by Tauber & Tauber, 1973a: 1164.] **Syn. n.**

Fore wing (Fig. 14) ♂, 11.5 mm; ♀, 12–12.5 mm. Head marked with black stripe on gena; red lateral stripe on frons and clypeus; red post-ocular spot often present. Maxillary palps black. Antenna shorter than fore wing. Pronotum marked with white longitudinal stripe, lateral margins sometimes marked reddish brown; prothoracic setae short, black. Claw (Fig. 16) with basal dilation usually less than one-third length of claw hook (3.7–5.17: 1; mean 4.26) but

specimens with black gradates have a large basal dilation (2.4–2.7:1). Fore wing narrow (length: breadth = 3.0–3.5: 1); pointed apically; venation mostly green but *c*₁/*c*₂ crossvein black, gradates green or black; costal setae short (0.4–0.8 mm), inclined towards wing apex; cell *im* short, not reaching 1st *Rs* crossvein or sometimes meeting apex of cell; 1st *Rs* crossvein meets *Rs* obliquely or at 90°; 4–6 inner gradates, 5–7 outer gradates.

GENITALIA. ♂ and ♀ and genitalia indistinguishable from *C. carnea*.

REMARKS. *C. downesi* and *C. plorabunda* are very similar morphologically and it is not always possible to distinguish the two species. However, some specimens of *downesi*, especially those from the western USA, are marked with a red post-ocular spot between the eye and vertex. This marking is never present in *plorabunda*. Other characters which serve to distinguish the two species are the white longitudinal prothoracic band in *downesi*, which is yellow in *plorabunda*, the basal dilation of the tarsal claw, which is generally smaller in *downesi* than *plorabunda*, and the width of the fore wing which tends to be narrower in *downesi* than *plorabunda*. However, these characters are prone to variation and cannot be relied upon to separate the species. Earlier workers (e.g. Tauber & Tauber, 1981) have considered *C. downesi* to have a dark green ground colour but, following courtship song analysis, Henry (1992) has shown that some populations of *C. downesi* include yellow individuals.

Tauber & Tauber (1977a) and Henry (1985a; 1985b) recognised *downesi* as a valid species on the basis of ecological evidence. *C. downesi* occurs in pine woodland and has a univoltine life cycle with a summer diapause. In life, the species has a year-round dark-green ground colour with a whitish median longitudinal band and is often covered with an oil-like secretion that is detectable in museum specimens. *C. plorabunda* occurs in deciduous woodland and open meadow habitats and has a multi-voltine life cycle with no summer diapause. The species is pale green in the summer but during the winter, *C. plorabunda* becomes reddish brown. Tauber & Tauber (1977a; 1977b) have postulated that *downesi* evolved from *plorabunda* through a process of habitat divergence and seasonal isolation. Henry (1985b) showed that the courtship songs of *downesi* and *plorabunda* were sufficiently different to cause reproductive isolation between the two taxa in the field. However, Henry (1985b) and Tauber & Tauber (1982a) were able to

hybridise *downesi* and *plorabunda* in the laboratory, although acceptance rates of heterospecifics were at low levels (10–30%). Hybridisation does not appear to occur in the wild (Henry, 1992).

Henry (1985a) reports on the occurrence of three distinct song morphs of *downesi* in the mountains of western USA. Morph D1 is widespread from eastern Canada to western Montana and south to California. However, this morph occurs sympatrically with a morphologically indistinguishable song morph (D2) in the northern Rocky Mountains. D2 co-occurs with a third song morph (D3) in central California which also cannot be separated using morphological characters.

Garland (1985b) states that the female specimen bearing the holotype label has a data label indicating that it was collected in Vernon rather than in Kelowna as stated in the original description (Smith, 1932).

The true status of *C. mohave* has been much discussed in the literature (Tauber & Tauber, 1973a; Henry, 1993). Morphologically the taxon differs from *C. plorabunda* in having the crossveins black at each end and the gradates completely black. Tauber & Tauber (1973b; 1982b; 1986; 1987) recognised *mohave* as a distinct 'strain' of *C. plorabunda*, with which it hybridises, on ecophysiological and life history grounds. Henry (1992; 1993) investigated the courtship song of specimens referable to *C. mohave* and found that they fell into two distinct groups. One group was indistinguishable from *C. johnsoni*, the other was the same as *C. downesi*. From a taxonomic point of view it is now impossible to decide whether *C. mohave* should be considered synonymous with *C. johnsoni* or *C. downesi*. In order to preserve nomenclatural stability I have decided to consider *C. mohave* as a synonym of *C. downesi*.

DISTRIBUTION. Nearctic.

MATERIAL EXAMINED (31♂, 18♀) USA: California, Colorado, New York, Oregon, Texas, Utah, Vermont, Wisconsin.

Chrysoperla zastrowi (Esben-Petersen)

(Figs 24–31)

Chrysopa zastrowi Esben-Petersen, 1928a: 220. Holotype ♀ [destroyed], NAMIBIA: Grootfontein (ZMH). Neotype ♀ NAMIBIA: Orupembe (LUND) [designated by Tjeder, 1966: 403.] [not examined].

Chrysopa (*Chrysoperla*) *zastrowi* (Esben-Petersen); Tjeder, 1966: 402.

Chrysoperla zastrowi (Esben-Petersen); Hölzel, 1989b: 167.

Fore wing (Fig. 24) ♂ 10.5–13 mm; ♀ 9.5–13 mm. Head sometimes unmarked or marked with dark brown (occasionally reddish) spot on gena; reddish brown lateral stripe on frons and clypeus; maxillary palps brown. Antennae shorter than fore wing. Pronotum with median longitudinal yellow band; sometimes with red or brown blotches in anterior corner. Basal dilation of claw small (4.0–5.0: 1; mean 4.38) Wing venation green; fore wing broad (length: breadth = 2.8–3.1: 1); costal setae moderately long (0.6–1.2 mm); 1st *Rs* crossvein leaves *Rs* at oblique angle.

GENITALIA♂ (Figs 26–28). Callus cercus rounded; 27–37 trichobothria. Gonosaccus with minute spicules; few gonosetae, about 5–6 arranged in lateral clump; apical membrane of arcessus short, blunt abruptly curved ventrad.

GENITALIA♀ (Figs 29–31). Callus cercus round; 32 trichobothria. Subgenitale with short basal extension. Spermatheca with deep ventral impression; vela long; duct long.

REMARKS. *C. zastrowi* is very similar to *C. carnea* but may be distinguished by the basal dilation of the claw, which is smaller in *C. zastrowi* than *C. carnea*. Tjeder (1966) notes that in *C. zastrowi* the 1st *Rs* crossvein is obliquely angled whereas in *carnea* this crossvein is at right-angles to *Rs*. However, this character is not always reliable since several Palaearctic specimens otherwise referable to *carnea* have an oblique crossvein. Nevertheless, in all southern African specimens examined the 1st *Rs* crossvein was oblique and never at right-angles to *Rs*. The male genitalia of *C. zastrowi* and *C. carnea* are indistinguishable.

DISTRIBUTION. Afrotropical.

MATERIAL EXAMINED (17♂, 13♀). Ascension I., Namibia, Somalia, St Helena, South Africa, Sudan, Zambia.

Chrysoperla furcifera (Okamoto)

(Figs 32–39)

Chrysopa furcifera Okamoto, 1914: 61. Lectotype ♀, TAIWAN: Shirin, 31.vii.1907 (*Matsumura*) (HU) [examined]. [Lectotype designated by Kuwayama, 1966: 136.]

Chrysopa savioi Navás, 1933c: 4. Holotype ♀, CHINA: Kowloon (IZAS) [not examined].
Syn. n.

Chrysopa kulingensis Navás, 1936b: 56. LECTO-TYPE ♂ HERE DESIGNATED. CHINA:

Kuling (IZAS) [examined]. [Synonymized with *savioi* by Yang *et al.*, 1990a: 82.]. **Syn. n.**

Chrysopa (Chrysoperla) furcifera Okamoto; Tjeder, 1966: 391.

Chrysoperla furcifera (Okamoto); Tsukaguchi, 1985: 504.

Anisochrysa (Chrysoperla) furcifera (Okamoto); Hölzel, 1970: 51.

Chrysoperla savioi (Navás); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 32) ♂, 11.5–12.5 mm; ♀, 15 mm. Head with broad black lateral stripe across gena, clypeus, labrum; in some specimens clypeus entirely black; large, black or reddish brown X-marking between antennae with arms extending onto lateral margins of vertex and epistomal suture; scape marked with black stripe on inner and outer lateral surface; maxillary palps black. Antennae shorter than fore wing; flagellar segments broad (length: breadth = 2: 1). Pronotum with broad brown lateral band and yellow longitudinal median band; prothoracic setae short, black. Claw (Fig. 33) undilated basally. Fore wing narrow (length: breadth = 3.4–3.7: 1), pointed at apex; venation entirely green; costal setae short or long (0.6–1.6 mm), erect or inclined towards wing apex; cell *in* relatively broad, 1st *Rs* crossvein meets *in* at apex or subapically; 4–10 inner gradates, 9–10 outer gradates; basal inner gradates not meeting *Psm*. Abdominal setae coarse, dense.

GENITALIA♂ (Figs 34–36). Dorsal apodeme of tergite 9 long, extending well beyond callus cercus; callus cercus broadly ovate or circular; 24–36 trichobothria. Lip of sternite 8+9 broad, rounded. Spinellae absent. Gonosaccus with minute spicules; few gonosetae, 6–15 in central clump; arcessus striated dorsally; apex tapering to point, abruptly curved ventrally. Entoprocessus large, crescentic. Gonarcus with large boot-shaped lateral plate; arch broad. Acumen of tignum long, narrow, slightly swollen apically.

GENITALIA♀ (Figs 37–39). Callus cercus round; 36 trichobothria. Subgenitale straight basally. Spermatheca with shallow ventral impression; duct long; vela long.

REMARKS. *C. furcifera* is one of the most distinctive species in the genus and can be readily recognized by the extensive black head markings and narrow, pointed fore wings. Other distinguishing characters include the lack of a basal dilation of the claws, broad flagellar segments,

dense abdominal setae and the inner basal gradate not meeting the pseudomedian vein. The lack of spinellae, striated arcessus, large entoprocessus and relatively few gonosetae indicate that *furcifera* is related to the *carnea*-group of species.

Yang & Yang (1992) distinguished the Chinese species *savioi* from the Japanese *furcifera* on the basis that the clypeus is marked black in *savioi* but unmarked in *furcifera*. However, in one Chinese example (of nine specimens examined in this study) the clypeus was only faintly brown (possibly an immature specimen) and in one Japanese specimen the clypeus was entirely reddish brown. No differences were detected in the genitalia of these two populations. In view of this the differences in markings noted by Yang & Yang (1992) do not seem to me to be sufficient to regard *savioi* and *furcifera* as distinct species.

GEOGRAPHIC VARIATION. Specimens examined from China and Hong Kong differed from other material in having darker, more extensive head markings. In these specimens the head markings are usually black rather than reddish brown. In addition, the inner stripe on the scape is considerably broader than the outer stripe and the clypeus is usually (but not invariably) entirely black. In specimens examined from other regions the clypeus is unmarked or suffused with red. Similarly, the Chinese specimens had dark brown antennae whereas material from other regions had the antennae pale brown. In addition, it was noted that the fringe of costal setae was generally longer in specimens from China and the Philippines (1.2–1.6 mm) than in specimens from Hong Kong and Japan (0.6–1.0 mm).

DISTRIBUTION. Bonin I. (Adams, 1959), China, Hong Kong, Japan, Philippines, Taiwan.

MATERIAL EXAMINED (6♂, 10♀). China, Hong Kong, Japan, Philippines, Taiwan.

Chrysoperla iranica (Hölzel)

(Figs 40–49)

Chrysopa (Chrysoperla) iranica Hölzel, 1967: 33. Holotype ♂, IRAN: Vanak, 1600m, 15km north of Teheran, 1–10.vii.1962 (*Vartian*) (HÖLZEL COLL) [examined].

Anisochrysa (Chrysoperla) iranica (Hölzel); Hölzel, 1970: 51.

Chrysoperla iranica (Hölzel); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 40) ♂, 9.5–10 mm; ♀, 10.5 mm. Head marked with narrow, dark brown stripe on gena and lateral clypeus. Maxillary palps black

dorsally. Antennae shorter than fore wing. Pronotum marked with median longitudinal white/yellow stripe; prothoracic setae short, pale. Claw (Fig. 41) with small basal dilation, about one-third length of claw hook (2.72: 1). Fore wing broad (length: breadth = 2.7–3.1: 1), rounded apically; costal setae quite long (0.8–1.0 mm), inclined towards wing apex; 4–6 inner gradates, 5–7 outer gradates; gradates green; crossveins black at each end, except costal and *Psm* crossveins which are green at the wing margins; anal veins green; cell *im* variable in length. Abdominal tergites with white/yellow median longitudinal band.

GENITALIA♂ (Figs 42–46). Lip of sternite 8+9 elongate, truncate apically with subapical constriction. Apodeme of tergite 9 long, extends far beyond callus cercus; callus cercus narrow, ovate; 27 trichobothria. Spinellae absent. Gonosetae few, 5–9 in lateral clump. Arcessus with dorsal striations; apex blunt; apical membrane short, bent ventrad at 90°. Entoprocessus large, crescentic. Gonarcus with lateral plate broad, reniform; arch broad. Acumen of tignum narrow, rounded apically.

GENITALIA♀ (Figs 47–49). Callus cercus ovate; 30 trichobothria. Subgenitale with narrow, short basal extension. Spermatheca with shallow ventral impression; duct long; vela long.

REMARKS. *C. iranica* belongs to the *carnea*-group of species. However, *iranica* can be distinguished from these species by the broad fore wing with rounded apex and, in males, by the extraordinary elongation of the lip on sternite 8+9.

DISTRIBUTION. Iran.

MATERIAL EXAMINED (3♂, 3♀) Iran.

Chrysoperla mediterranea (Hölzel)

(Figs 50–58)

Anisochrysa (*Chrysoperla*) *mediterranea* Hölzel, 1972: 81. Holotype ♂, TUNISIA: Biserta, 100m, 9.viii.1971 (Gepp) (HÖLZEL COLL.) [not examined].

Anisochrysa mediterranea (Hölzel); Monserat, 1977: 130.

Chrysoperla mediterranea (Hölzel); Aspöck *et al.*, 1980: 269.

Fore wing (Fig. 50) ♂, 8.5–9.5 mm; ♀, 11 mm. Head sometimes entirely suffused red or marked with red/brown stripe on gena, frons and clypeus; labrum sometimes red; red post-ocular spot sometimes present. Maxillary palps black dor-

sally or unmarked. Antennae shorter than fore wing. Pronotum marked with longitudinal median yellow stripe and sometimes with brown median dorso-lateral spot; prothoracic setae short, black or pale. Claw (Fig. 51) with minute basal dilation (8.25: 1). Fore wing narrow (length: breadth = 3.2–4.0: 1); venation green; costal setae short (0.4–0.6 mm), inclined towards wing apex; cell *im* short, apex of cell not reaching 1st *Rs* crossvein; 4–6 inner gradates, 5–7 outer gradates.

GENITALIA♂ (Figs 52–55). Membranous lip of sternite 8+9 broad, rounded. Apodeme of tergite 9 long, extending well beyond callus cercus; 23–24 trichobothria. Spinellae absent. Gonosetae few, 5–6 in lateral clump. Arcessus with dorsal striations; straight but extreme apex bent ventrad at 90°, apex blunt. Entoprocessus large, crescentic. Lateral plate of gonarcus large, reniform; arch broad. Acumen of tignum long, rounded (not swollen) apically.

GENITALIA♀ (Figs 56–58). Callus cercus ovate; 28 trichobothria. Subgenitale with short basal projection. Spermatheca narrow; ventral impression deep; duct long.

REMARKS. *C. mediterranea* is apparently closely related to *carnea* and shares several characters with that species. Like *carnea* the gena is marked with a brown stripe, the wing venation is green, costal setae short and intramedian cell short. Similarly, the male genitalia of both species have many characters in common: spinellae are absent, the arcessus is dorsally striated and there are few gonosetae. However, the wings are narrower in *mediterranea* and the basal dilation of the claw much smaller than in *carnea* and other related species. On the basis of these characters it seems justified to continue to treat *mediterranea* as a distinct species.

Duelli (1987) described a population of green lacewings referable to *mediterranea* from Switzerland. The population occurred sympatrically with *carnea* but was ecologically separated since *carnea* was confined to oak whereas *mediterranea* was found on pine. In the laboratory the taxa interbred and produced fertile hybrids.

Cianchi & Bullini (1992) report that their electrophoretic work on this Swiss population of *mediterranea* suggests it is genetically distinct from other populations of *mediterranea* (although they do not state which populations they examined) and should be considered a distinct taxon. However, until comparable data is available from a wide range of populations of this

species it is premature to formally recognise the taxa as distinct species.

DISTRIBUTION. North-west Africa, south-west Europe, Hungary (Szentkirályi, pers comm.), Switzerland (Duelli, 1987).

MATERIAL EXAMINED (2♂, 1♀) Algeria, mainland Spain, Majorca.

***Chrysoperla nipponensis* (Okamoto) stat. rev.**

(Figs 59–67)

Chrysopa nipponensis Okamoto, 1914: 65. Lectotype ♂, JAPAN: Kyushu, Kumamoto, 4.iv.1907 (*Kawamura*) [Lectotype designation by Kuwayama, 1966: 135.] (HU) [examined].

Chrysopa kurisakiana Okamoto, 1914: 71. Lectotype ♀, JAPAN: Mt Fuji, 23.vi.1911 [Lectotype designation by Kuwayama, 1966: 135.] (HU) [not examined]. [Synonymized by Kuwayama, 1962: 11.]

Chrysopa ilota Banks, 1915: 629. Holotype ♀, PHILIPPINE IS: Luzon, Mt Makiling (*Baker*) (MCZ) [examined]. **Syn. n.**

Chrysopa kolthoffi Navás, 1927b: 3. Lectotype ♀, CHINA: Kiangsu (*Kolthoff*) [Lectotype designation by Leraut, 1991: 79.] (MNHN) [examined]. [Synonymized with *carnea* by Tjeder, 1936: 32; raised to valid species by Leraut, 1992: 63.] **Syn. n.**

Chrysopa kolthoffi var. *adaptata* Navás, 1934a: 2. Holotype ♀, CHINA: Jiangsu Prov., Hufu (Loubou), 3.viii.1933 (IZAS) [not examined]. **Syn. n.**

Chrysopa sinica Tjeder, 1936: 29. Holotype ♂, CHINA: South Kansu, Ardjuan, 2900m, 8.ix.1930 (*Sjostedt*) (NRS) [examined]. **Syn. n.**

Chrysopa (*Chrysoperla*) *sinica* Tjeder; Tjeder, 1966: 391.

Anisochrysa (*Chrysoperla*) *sinica* (Tjeder); Hölzel, 1970: 51.

Chrysoperla nipponensis (Okamoto); Tsukaguchi, 1985: 504 [as synonym of *Chrysoperla carnea* (Stephens)].

Anisochrysa (*Chrysoperla*) *sinica* (Tjeder); Hölzel, 1970: 51.

Chrysopa (*Chrysoperla*) *sinica* Tjeder; Tjeder, 1966: 391.

Fore wing (Fig. 59) ♂, 10.5–13 mm; ♀, 12.5 mm. Head marked with black/brown stripe on gena and lateral clypeus; lateral frons sometimes marked with red stripe. Maxillary palps black dorsally. Antennae shorter than fore wing. Pronotum marked with median yellow longitudinal band and pale brown lateral stripe; protho-

racic setae long or short, pale. Claw (Figs 60, 61) with large basal dilation, about half length of claw hook (2.07–2.42: 1; mean 2.22). Fore wing relatively broad (length: breadth = 2.9–3.1: 1); apex pointed; costal setae long (1.0–2.4 mm), inclined towards wing apex; cell *in* short, not meeting 1st *Rs* crossvein; 1st *Rs* crossvein usually at right-angles to *Rs*; 4–6 inner gradates, 6–7 outer gradates; gradates black; crossveins dark at each end except costal and *Psm* crossveins which are unmarked at the wing margins.

GENITALIA♂ (Figs 62–64). Dorsal apodeme of tergite 9 long, extending beyond callus cercus; callus cercus broad, ovate; 27–33 trichobothria. Membranous apex of sternite 8+9 broad, rounded. Spinellae absent. Gonosacculus with minute spicules; gonosetae few, 5–7 in lateral clump. Arcessus with dorsal striations; apex blunt, curved ventrally at 90°. Entoprocessus large, crescentic. Gonarcus lateral plate broadly reniform; arch broad. Acumen of tignum long, narrow, rounded apically.

GENITALIA♀ (Figs 65–67). Callus cercus round; 32 trichobothria. Subgenitale with short, narrow basal extension. Spermatheca with shallow ventral impression; duct long; vela long.

REMARKS. *C. nipponensis* is closely related to *carnea* and the male genitalia of the two species appear to be indistinguishable. However, there are consistent differences in the external morphology that suggest they should be treated as distinct species. In *nipponensis* the gradates are black, the costal setae relatively long and the basal dilation of the claw is about half the length of the claw hook. In addition, the gena and lateral clypeus is heavily marked dark brown/black, the prothoracic setae are pale and the acumen of the tignum is relatively long (Fig. 63). In *carnea* the gradates are green, costal setae generally short and the basal dilation of the claw is about one-third the length of the claw hook. In most examples of *carnea* examined the genal markings are less extensive and paler, the prothoracic setae are black and the acumen is shorter.

Yang & Yang (1990a) examined the male type of *Chrysopa chusanina* Navás and commented that the genitalia indicated the species should be transferred to *Chrysoperla*. They also considered that the species may be a synonym of *C. sinica* Tjeder. Unfortunately, I have not been able to borrow the type of *C. chusanina* so cannot confirm this view. However, the original description of *C. chusanina* (Navás, 1933c) does not resemble that of *sinica* Tjeder. Navás describes

the palps as yellow, a red arcuate stripe in front of the antennae, a red lateral stripe on the head and a red lateral stripe on the pronotum. None of these markings occur in *sinica*. However, without access to the type material it is impossible to decide the true affinities of the species.

Thierry *et al.*, (1992) and Leraut (1992) incorrectly refer to a French morph of *carnea* as *koltshoffi*.

GEOGRAPHICAL VARIATION. Korean specimens and some of the Chinese material examined have a red stripe on the lateral frons that is absent in Japanese material.

The Mongolian paratypes of *sinica* have the gena marked with a narrow, pale brown stripe and in one specimen the gradate crossveins were green, not marked black.

DISTRIBUTION. China, Japan, Korea, Mongolia, Philippines.

MATERIAL EXAMINED (9♂, 15♀) China, Japan, Korea, Mongolia.

Chrysoperla renoni (Lacroix)

(Figs 68–75)

Chrysopa renoni Lacroix, 1933: 149. Lectotype ♂, FRANCE: Deux-Sèvres, Amuré, 29.vi.1930 (Lacroix) [Leraut, 1991: 72. Lectotype designation.] (MNH) [examined].

Chrysoperla ankylopteryformis Monserrat & Diaz-Aranda, 1989: 261. Holotype ♂, SPAIN: Almeria, Rambla de Morales (Cabo de Gata), 10m, 12.viii.1988 [MONSERRAT COLL] [examined]. **Syn. n.**

Fore wing (Fig. 68) ♂, 10.5 mm; ♀, 11.5 mm. Head marked with brown stripe on gena and lateral clypeus. Maxillary palps unmarked or black dorsally. Antenna very short, little more than half length of fore wing. Pronotum marked with median longitudinal white/yellow band, vague broad pale reddish medio-lateral red stripe, narrow antero-ventro-lateral black stripe; prothoracic setae very long, pale; setal follicles sometimes marked black. Claws with minute basal dilation (10.25: 1), claw tooth elongate (Fig. 69). Fore wing variable in width (length: breadth = 2.8–3.7: 1); rounded apically; venation mainly green with costal crossveins sometimes black at subcosta; costal setae long (1.8–2.4 mm), erect; cell *im* short, not reaching 1st *Rs* crossvein; 1st *Rs* crossvein meets *Rs* obliquely; 4–6 inner gradates, 5–6 outer gradates.

GENITALIA ♂ (Figs 70–72). Dorsal apodeme of

tergite 9 long, extending well beyond callus cercus; callus cercus broad, ovate; 30 trichobothria. Lip of sternite 8+9 narrow, prominent. Spinellae absent. Gonosetae few, 5 arranged in lateral clump. Arcessus broad with dorsal striations; apex blunt, curved at 90°. Entoprocessus large, crescentic. Gonarcus with broad lateral plate; arch broad. Acumen of tignum broad, not swollen apically.

GENITALIA ♀ (Figs 73–75). Callus cercus broad, ovate; 26 trichobothria. Subgenitale with short, broad basal extension. Spermatheca with shallow ventral impression; duct long; vela short.

REMARKS. On the basis of the male genitalia, *C. renoni* belongs to the *carnea*-group of species. I could detect no useful characters in the gonarcus-complex to distinguish *renoni* from other species in this group. However, the acumen of the tignum is shorter and broader in *renoni* than in males of *carnea*. In females of *renoni* the basal lobe of the subgenitale is longer than usual in other members of the *carnea*-group. From other *Chrysoperla* species *renoni* can be readily identified by the long prothoracic and costal setae and the minute basal dilation of the claw. The claws of *C. mediterranea* also have a minute basal dilation but the claw hook is much shorter than in *renoni* and not at right angles to the claw base. In addition, the fore wings of *mediterranea* are much narrower than in *renoni* and are pointed apically rather than rounded.

The present synonymy between *C. renoni* and *C. ankylopteryformis* confirms the suggestions of Leraut (1991) and Aspöck (1992).

DISTRIBUTION. France, Spain.

MATERIAL EXAMINED (3♂, 3♀, 1 without abdomen)

France (including lectotype of *renoni*), Spain (holotype and two paratypes of *ankylopteryformis*).

Chrysoperla oblita (Hölzel)

(Figs 76–83)

Anisochrysa (*Chrysoperla*) *oblita* Hölzel, 1973: 342. Holotype ♂, NEPAL: Jiri, 12.vi.1964 (Remane) (ZSBZ) [examined].

Chrysoperla oblita (Hölzel); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 76) ♂, 10.5–11 mm; ♀, 10.5–13 mm. Head marked with broad reddish band across gena, lateral clypeus and labrum, markings sometimes extending onto lateral frons and medio-lateral area of clypeus; red post-

ocular spot. Maxillary palps unmarked. Antennae as long as fore wing. Pronotum with median longitudinal yellow band and red spot in anterior corner; prothoracic setae long or short, pale. Claw (Fig. 77) with large basal dilation, about half length of claw hook (1.88–2.14: 1; mean 2.01). Fore wing with gradates black; other crossveins dark each end, except *Psm* crossveins entirely green; upper branch of forking marginal veins black; anal veins green; apex of wing rounded; costal setae long (1.0–1.2 mm), erect or slightly inclined towards wing apex; 5–7 inner gradates, 6–8 outer gradates; cell *in* long, 1st *Rs* crossvein meets *in* at apex or subapically; 1st *Rs* crossvein leaves *Rs* at right-angles or obliquely.

GENITALIA♂ (Figs 78–80). Lip of sternite 8+9 broad, truncate, at 45° to sternite. Apodeme of tergite 9 long, extending beyond callus cercus; callus cercus broad, ovate; 28–30 trichobothria. Spinellae absent. Gonosacculus with minute spicules; gonosetae few, 9–12 in lateral clump. Arcessus with dorsal striations; apex blunt, curved evenly ventrad. Entoprocessus large, crescentic. Gonarcus broad, lateral plate foot-shaped; arch broad. Acumen of tignum short, very broad, rounded apically.

GENITALIA♀ (Figs 81–83). Callus cercus rounded; 25 trichobothria. Subgenitale concave basally with median projection. Spermatheca with shallow ventral impression; duct long; vela short.

REMARKS. *C. oblita* belongs to the group of species related to *carnea* that have a striated arcessus and lack spinellae in the male genitalia. However, the species differs from others in the group by having relatively more gonosetae in the male genitalia (*carnea* has only 5–6 in each lateral group), the gena marked red instead of brown and a large basal dilation of the claw. *C. oblita* is readily identifiable by the black gradate crossveins, long costal setae and the broad acumen in the male genitalia.

The holotype of *oblita* is now in poor condition. Both fore wings are broken off at the base. The apex of the abdomen is preserved in a vial of glycerine but the internal genitalic components (gonarcus, arcessus and tignum) are all missing. However, Hölzel's (1973) figures and description of the type are sufficient for positive identification of the species.

DISTRIBUTION. Highlands of northern Thailand, Nepal and north-west India. All specimens were collected between 1380 and 1700m.

MATERIAL EXAMINED (4♂, 8♀). Thailand:

Chiang Mai Province. India: Assam, Khasia Hills. Nepal.

Chrysoperla annae sp. n.

(Figs 84–89)

Fore wing (Fig. 84) ♂, 13.5 mm; ♀ unknown. Head marked with reddish brown stripe on gena and lateral clypeus, red stripe on frontal suture. Maxillary palp black dorsally. Antenna shorter than fore wing. Pronotum with yellow longitudinal median band; setae short, black. Claw (Fig. 85) with small basal dilation, one-quarter or less than claw hook length (3.25–9.75: 1; mean 6.5). Fore wing narrow (length: breadth = 3.1–3.3: 1), venation green; costal setae moderately long (0.8–1.0 mm), inclined towards wing apex; 1st *Rs* crossvein meets *in* subapically; 6–7 inner gradates, 7–9 outer gradates.

GENITALIA♂ (Figs 86–89). Dorsal apodeme of tergite 9 short; callus cercus broadly ovate; 25–28 trichobothria. Lip of sternite 8+9 broad, truncate when viewed ventrally. Spinellae absent. Gonosacculus with 12–20 gonosetae in lateral group. Arcessus narrow, straight, striated dorsally; apex rounded, straight or curved ventrad at 90°. Entoprocessus small, narrow, crescentic. Lateral plates of gonarcus narrow, reniform; arch broad. Acumen of tignum moderately long, narrow not swollen apically.

REMARKS *Chrysoperla annae* belongs to the *carnea*-group of species. However, the new species possesses several distinctive characters that distinguish it from other species in the group. In the male genitalia the arcessus, entoprocessus and the lateral plates of the gonarcus are narrower than in *carnea* and there are 12–20 gonosetae, instead of six, in each lateral group. The relatively narrow fore wing with rounded apex is also characteristic of the species.

DISTRIBUTION. Burma, Tibet.

MATERIAL EXAMINED (2♂) Holotype ♂, Tibet: Tsaidam (*Prejevdoky*) (BMNH). Paratype ♂, Burma: Tongkruk, 9,000, 20.vii.1931 (*Kingdon Ward*) (BMNH).

Chrysoperla gallagheri Hölzel

(Figs 90–98)

Chrysoperla gallagheri Hölzel, 1989a: 60. Holotype ♂, OMAN: Jabal Shams, 2500m, 23.15N/57.15E, 16.vii.1987 (*Gallagher*) (HÖLZEL COLL.) [examined].

Fore wing (Fig. 90) ♂, 9.5–10.5 mm; ♀, 12 mm. Head marked with broad red stripe across gena, lateral frons, lateral clypeus; red post-ocular stripe; head sometimes suffused entirely red; lateral scape and pedicel with red stripe. Maxillary palp unmarked. Antenna about same length as fore wing. Pronotum unmarked, pale median longitudinal stripe absent but yellow/green median stripe present on pteronotum; prothoracic setae long, black; follicles unmarked. Claw (Fig. 91) with small basal dilation, less than a quarter length of claw hook (5.5: 1). Abdomen marked with dorsal median yellow stripe on tergites 1–3. Fore wing (length: breadth = 2.9–3.0: 1), pointed apically; costal setae relatively long (1.0 mm), inclined towards wing apex; 4–5 inner gradates, 5–7 outer gradates; gradates black; crossveins black each end; 1st *Rs* crossvein meets cell *im* at apex; 1st *Rs* crossvein straight or oblique.

GENITALIA♂ (Figs 92–95). Lip of sternite 8+9 narrow, rounded apically; apex of sternite 8+9 narrowed to form prominent tubercle. Apodeme of tergite 9 long, extending far beyond callus cercus; callus cercus moderately narrow, ovate; 26 trichobothria. Spinellae absent. Gonosetae numerous, formed into lateral group. Arcessus with dorsal striations; apical membrane long, narrow, curved at 45°, rounded at tip. Entoprocessus short, narrow, crescentic. Acumen of tignum short, broad, swollen; arms of tignum narrow.

GENITALIA♀ (Figs 96–98). Callus cercus ovate; 33 trichobothria. Subgenitale with short, narrow basal extension. Spermatheca with deep ventral impression; duct long; vela short.

REMARKS. Like *C. pudica* and *mutata*, the gradates of *gallagheri* are black. However, *gallagheri* may be distinguished from these species by the small basal dilation of the claw, the red stripe on the scape and, in males, by the absence of spinellae.

DISTRIBUTION. Oman.

MATERIAL EXAMINED (2♂, 2♀) Oman.

Chrysoperla comans (Tjeder)

(Figs 99–108)

Chrysopa (*Chrysoperla*) *comans* Tjeder, 1966: 408. Holotype ♂, ZIMBABWE: Umtali, 14.i.1945 (Wright)(TM) [not examined].

Chrysoperla comans (Tjeder); Hölzel, 1989b: 175.

Chrysoperla manselli Hölzel, 1989b: 176. Holo-

type ♂, SOUTH AFRICA: Transvaal, Vredenhuis gardens of Union Buildings, 25.45S/28.12E, 1.x.1979, at light (Mansell) (NCI) [examined]. Syn. n.

Fore wing (Fig. 99) ♂, 10.5–11.5 mm; ♀, 12.0–13.5 mm. Head usually marked with red lateral stripe on gena and clypeus; red post-ocular stripe. Maxillary palps unmarked. Antennae about as long as fore wing. Pronotum marked with red spot in anterior corner and yellow median, longitudinal band; prothoracic setae long (2.2–3.0 mm), pale. Claw (Fig. 100) with large basal dilation, about two-thirds length of claw hook (1.59–1.71: 1; mean 1.65). Fore wing broad, with brown gradates; costal setae long (2.2–3.0 mm), erect; 5–8 inner gradates, 6–9 outer gradates; 1st *Rs* crossvein meets *im* apically or sub-apically.

GENITALIA♂ (Figs 101–105). Sternite 8+9 elongate; lip small, broad. Callus cercus small, narrow, ovate; 26 trichobothria. Apodeme of tergite long, often branched, extending considerably beyond callus cercus. Spinellae absent. Gonosetae short, numerous, evenly dispersed across gonosaccus. Arcessus narrow, apical membrane long, blunt, slightly curved or recurved ventrad, not striated dorsally. Entoprocessus small crescentic. Lateral plate of gonarcus ovate or boot-shaped. Acumen of tignum short, grossly swollen.

GENITALIA♀ (Figs 106–108). Callus cercus ovate; 26 trichobothria. Subgenitale with short basal projection. Spermatheca with deep ventral impression; duct long; vela long.

REMARKS. *C. comans* belongs to the group of Afrotropical broad-winged species with long, erect costal setae. From *nyerina* and *plicata* it can be distinguished by the absence of spinellae. *C. comans* can be distinguished from the Madagascan species, *decaryana*, by the narrow arcessus, short, swollen acumen and the narrow, elongate apex of sternite 8+9. In *decaryana* the arcessus is broad, the acumen narrow and sternite 8+9 is not elongated apically.

When he described *manselli*, Hölzel (1989b) remarked on the similarities between *manselli* and *comans*, in particular the elongation of sternite 8+9, which does not occur elsewhere in the genus. However, he then went on to say that the gonarcus complex and tignum were totally different in the two taxa. Nevertheless, on re-examination of the types of *manselli* I can see no significant differences in the genitalia from that described by Tjeder (1966) for *comans*.

Indeed Hölzel's (1989b) figure of the acumen of *manselli* shows it less swollen than it is in fact.

DISTRIBUTION. Kenya, Zimbabwe, South Africa.

MATERIAL EXAMINED (3♂, 3♀). South Africa, Kenya.

Chrysoperla decaryana (Navás)

(Figs 109–114)

Chrysopa decaryana Navás, 1934b: 60. Holotype♂, MADAGASCAR: Tananarive, 1921 (*Decary*) (MNHN) [examined].

Chrysoperla decaryana (Navás); Hölzel, 1989b: 169.

Fore wing (Fig. 109) ♂, 13 mm; ♀ unknown. Head marked with broad red lateral stripe on gena, frons and clypeus; red post-ocular stripe. Maxillary palp with black dorsal stripe. Antenna shorter than fore wing. Pronotum marked with yellow/white median longitudinal band and red medio-lateral spot; prothoracic setae long, pale. Basal dilation of claw large, about half length of claw hook (2.25: 1) (Fig. 110). Fore wing broad (length: breadth = 3: 1); costal setae long (1.6 mm), slightly inclined apically; *Rs* crossveins sinuate; gradates black and other crossveins dark at each end except costals at costa and *Psc* crossveins entirely green; 1st *Rs* crossvein meets *im* at apex.

GENITALIA♂ (Figs 111–114). Lip of sternite 8+9 narrow, tapering apically, prominent; callus cercus narrow, ovate; 32 trichobothria; apodeme of tergite 9 short, not extending beyond callus cercus, branched. Spinellae absent. Gonosaccus with minute spicules. Gonosetae few (about 14) in median group. Entoprocessus minute, crescentic. Arcessus lacking dorsal striations; short, broad, straight; apex blunt, rounded. Gonarcus with broad arch; basal dilation narrow wedge. Acumen of tignum long, parallel sided, rounded apically; arms narrow.

REMARKS. *C. decaryana* belongs to the group of Afrotropical species with broad wings and long costal setae. It is probably most closely related to *comans* Tjeder since both species lack spinellae in the male genitalia. However, from this species *decaryana* can be distinguished by the broad arcessus and relatively narrow acumen.

MATERIAL EXAMINED (1 ♂). Madagascar.

Chrysoperla siamensis sp. n.

(Figs 115–123)

Fore wing (Fig. 115) ♂, 11–12.5 mm; ♀, 14 mm. Head sometimes unmarked or marked with reddish spot on lateral clypeus, extending to medio-lateral area; red spot on lateral frons which sometimes extends posteriorly as stripe between eye and scape; red post-ocular stripe; gena unmarked, or sometimes with red spot. Maxillary palps unmarked. Antennae shorter than fore wing. Pronotum marked with yellow median longitudinal band, bordered yellow/orange, sometimes marked with red medio-lateral spot; prothoracic setae short, pale. Claw (Fig. 116) with large basal dilation, over half length of claw hook (1.86: 1). Fore wing broad (length: breadth = 2.8–3.0: 1); rounded apically; costal setae long (1.0–1.4 mm), erect; 1st *Rs* crossvein leaves *Rs* at oblique angle; 1st *Rs* crossvein meets cell *im* subapically; *Rs* crossveins sinuous; gradates green or greyish with surrounding membrane suffused grey, other veins green; 4–7 inner gradates, 6–8 outer gradates.

GENITALIA♂ (Figs 117–120). Lip of sternite 8+9 broad, rounded. Dorsal apodeme of tergite 9 extending beyond callus cercus; callus cercus broad, ovate; 23–38 trichobothria. Spinellae absent. Gonosetae numerous in median group. Arcessus lacking dorsal striations; narrow, curving in apical half to 90°; membranous tip very long and narrow, blunt apically. Entoprocessus very small, narrow, crescentic (not visible in some specimens examined). Gonarcus with lateral plates broad, ovate; arch broad. Acumen of tignum short, swollen apically.

GENITALIA♀ (Figs 121–123). Callus cercus ovate; 28 trichobothria. Subgenitale with narrow basal extension. Spermatheca with shallow ventral impression; duct short; vela short.

REMARKS. *C. siamensis* is unusual amongst *Chrysoperla* species in lacking both spinellae and dorsal striations on the arcessus in the male genitalia. The only other species that also lack these characters are *comans*, *decaryana* and *galagheri*. Other distinctive characters of *siamensis* are the broad, rounded fore wing with a grey suffusion around the gradate crossveins, the relatively long intramedian cell, sinuous *Rs* crossveins and short pale prothoracic setae. In addition, the arcessus is very narrow and the lip of sternite 8+9 unusually broad.

DISTRIBUTION. Thailand.

MATERIAL EXAMINED (5♀, 2♀) Holotype ♂,

Thailand: Chiang Mai Prov., Mae Rim to Samoeng Road, 24 Km post, 1100m, 29.i.1989 (*Cotton*) (BMNH). Paratypes. Thailand: 2♂, Korat Prov., Khao Yai National Park, Khao Kieow, 1200m, 1.iii.1989 (*Cotton*); 1♀, Chiang Mai Prov., Doi Suthep-Pui National Park, 1380m, 24.ii.1989 (*Cotton*); 1♂, 1♀, Doi Suthep-Pui National Park, 1460m, 26.iv–10.v.1989 (*Cotton*); 1♂, Doi Suthep-Pui National Park, 1200m, 10–11.xi.1988 (*Bradley, Lewvanich, Fletcher*) (BMNH).

Chrysoperla nyerina (Navás)

(Figs 124–132)

Chrysopa nyerina Navás, 1933a: 210. Holotype ♂, KENYA: Nyeri, 9.vi.1932 (MNHN) [examined].

Chrysopa socia Navás, 1936a: 116. Lectotype ♀, KENYA: Marakwet, Elgeyo Escarpment, 2500m, 1932–33 (*Arambourg, Chappuis & Jeannel*) [Lectotype designation by Hölzel, 1989b: 173.] (MNHN) [examined]. **Syn. n.**

Chrysoperla nyerina (Navás); Hölzel, 1989b: 172.

Chrysoperla socia (Navás); Hölzel, 1989b: 173.

Fore wing (Fig. 124) ♂, 13–14.5 mm; ♀, 13.5–15 mm. Head occasionally unmarked or marked with broad red lateral stripe on gena and clypeus; red post-ocular spot. Maxillary palps black dorsally, sometimes unmarked. Specimens examined from Uganda had a red lateral stripe on the scape, otherwise scape unmarked. Pronotum with longitudinal yellow median band, sometimes with red spot in anterior corner; prothoracic setae very long, pale. Claw (Fig. 125) with large basal dilation, about two-thirds length of claw hook (1.77–1.89: 1; mean 1.83). Fore wing broad (length: breadth = 2.6–2.8: 1); costal setae long (1.8–2.6 mm), erect; gradates black and other crossveins dark at each end (except *Psc* crossveins which are green at wing margin); 6 inner gradates, 6–7 outer gradates; *im* long, 1st Rs crossvein meets *im* sub-apically. Abdomen with pair of red dorsal spots on basal segments.

GENITALIA♂ (Figs 126–129). Lip of sternite 8+9 broadly rounded. Apodeme of tergite 9 long, extends far beyond callus cercus; callus cercus broad, ovate; 21–36 trichobothria. Few (about 20) minute spinellae, each spine on an individual tubercle. Gonosetae numerous, evenly distributed on gonosaccus. Entoprocessus small, crescentic. Arcessus long, narrow with dorsal striations; weakly curved ventrad; truncate apically. Gonarcus with narrow lateral plate. Acu-

men of tignum long, parallel sided, rounded apically.

GENITALIA♀ (Figs 130–132). Callus cercus ovate; 25 trichobothria. Subgenitale broad. Spermatheca narrow; ventral impression deep; vela short; duct long.

REMARKS. *C. nyerina* is probably closely related to *plicata* since this is the only other species in the genus with simple spinellae. However, there are several characters that will distinguish the species. In *nyerina* the basal dilation of the claw is larger than in *plicata*. In the male genitalia the apex of the acumen is not swollen in *nyerina* and it has fewer and smaller spinellae than *plicata*. In *plicata*, unlike *nyerina*, the spinellae are not set in tubercles.

DISTRIBUTION. Kenya, Sudan, Uganda.

MATERIAL EXAMINED (4♂, 6♀) Kenya, Sudan, Uganda

Chrysoperla plicata (Tjeder)

(Figs 133–141)

Chrysopa (Chrysoperla) plicata Tjeder, 1966: 406. Holotype ♂, ZIMBABWE: Marandellas, Eirene Farm, x.1960 (NHMZ) [examined].

Chrysopa plicata (Tjeder); Hölzel, 1989b: 168.

Fore wing (Fig. 133) ♂, 9.5–12.5 mm; ♀, 12.5–13 mm. Head marked with strong red spot; red post-ocular stripe. Maxillary palps unmarked. Antennae about as long as fore wing. Pronotum marked with red stripe in each corner and red centro-lateral spot; median longitudinal yellow band; prothoracic setae pale, long or short. Claw (Fig. 134) with large basal dilation, about two-thirds length of claw tooth (1.58: 1); rounded posteriorly. Fore wing marked with black spot on tympanal organ; crossveins black at each end (except marginal crossveins at wing margin); gradates black; 3–7 inner gradates, 4–8 outer gradates; costal setae long (1.0–1.8 mm), slightly inclined; *im* variable in length.

GENITALIA♂ (Figs 135–138). Apodeme of tergite 9 variable, usually not extending beyond callus cercus; 21–30 trichobothria; lip of sternite 8+9 prominent, strongly tapered apically when viewed ventrally. Spinellae present, numerous, single broad spines not mounted on tubercle. Gonosetae numerous, evenly distributed across gonosaccus. Arcessus with dorsal striations; blunt apically, weakly curved. Entoprocessus short, narrow, triangular. Gonarcus with wide arch and median projection; lateral plates broad,

reniform. Acumen of tignum short, broad, bulbous apically.

GENITALIA♀ (Figs 139–141). Callus cercus rounded; 29 trichobothria. Subgenitale with large basal extension. Spermatheca narrow; ventral impression shallow; vela short; duct long.

REMARKS. Males of *C. plicata* are unusual amongst *Chrysoperla* species in that the arcessus is striated and spinellae are present. The only other species to share these characters is *nyerina*. *C. plicata* also shares with *nyerina* simple spinellae in the male genitalia. Unlike *nyerina*, however, the spinellae of *plicata* arise directly from the gonosaccus and are not raised on tubercles. In most other species in the genus which possess spinellae, these structures are composed of several spines positioned on each tubercle. *C. plicata* may be distinguished from other *Chrysoperla* species by the strongly defined red spot on the gena and the three red lateral stripes on the pronotum. In addition, the claw is strongly reflexed and has a large basal dilation.

Tjeder's (1966) figure of the male genitalia of *plicata* shows the apex of the arcessus strongly hooked. In the specimens examined during this study all had the arcessus only weakly curved. Unfortunately, the genitalia of the holotype have been slide mounted in such a way that it is impossible to see the extent of the curvature of the arcessus in the holotype.

DISTRIBUTION. Afrotropics.

MATERIAL EXAMINED (9♂, 3♀) Mozambique, Sene-Gambia, Somalia, South Africa, Zaïre, Zambia, Zimbabwe.

Chrysoperla insulata (Fraser)

(Figs 142–148)

Chrysopa insulata Fraser, 1957: 26. Syntypes♂ ♀, RÉUNION: Hellbourg; forest track in the forest of Bélouze; Bébour & Plaine des Cafres, Piton Manuel, I. 1955 (*Paulian*) (IRSM & BMNH) [1♂, 1♀ syntype in BMNH examined].

Chrysoperla insulata (Fraser); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 142) ♂, 13 mm; ♀, 16.5 mm. Head marked with black lateral stripe on clypeus. Maxillary palps black. Antennae shorter than fore wing. Pronotum with median longitudinal yellow band; prothoracic setae short, pale. Claw (Fig. 143) with large basal dilation, over half the length of claw hook (2.21: 1). Fore wing broad (length: breadth = 28.–2.9: 1), pointed

apically; costal setae long (2.4–2.8 mm), erect; *im* long, apex extends beyond 1st *Rs* crossvein; gradates black; 8–9 inner gradates, 9–10 outer gradates; other crossveins darkened at each end.

GENITALIA♂ (Figs 144–145). Lip of sternite 8+9 broad, rounded; apodeme of tergite 9 short, not extending beyond callus cercus; 31 trichobothria. Spinellae present, numerous, 2–3 spines on tubercle. Gonosetae numerous, arranged in lateral group. Arcessus narrow; lacking dorsal striations; strongly curved ventrad; apical membrane long, narrow, truncate at apex. Entoprocessus minute, narrow, straight. Gonarcus narrowly expanded basally. Tignum absent.

GENITALIA♀ (Figs 146–148). Callus cercus ovate; 39 trichobothria. Subgenitale broad with narrow basal extension. Spermatheca with moderate ventral impression; vela short; duct long.

REMARKS. *C. insulata* is unique amongst *Chrysoperla* species because the tignum is absent in the male genitalia. The species is also characterized by the relative lack of head markings, only the clypeus is marked with a lateral black stripe, and the broad distinctly pointed fore wings. *C. insulata* is the largest *Chrysoperla* species with a fore wing length of 16.5 mm in females.

DISTRIBUTION. Réunion.

MATERIAL EXAMINED (1♂, 1 ♀ syntypes) Réunion.

Chrysoperla pudica (Navás)

(Figs 149–159)

[*Hemerobius brevicollis* Rambur, 1842: 427.

Holotype sex unknown, Mauritius (*Marchal*) [not traced]. [*Nomen dubium*]

Chrysopa pudica Navás, 1914a: 82. Holotype ♂, SOUTH AFRICA: Transvaal, Piet Retief (*Crawshay*) (BMNH) [examined].

Chrysopa incongrua Navás, 1914c: 97. Holotype, sex unknown, SENEGAL-NIGER: Koulikoro (NAVAS COLL.) [type not traced]. Provisional synonym.

Chrysopa nigriciana Navás, 1931b: 119. Holotype ♀, NIGERIA: Guezzan & Air, Prince Sixte de Bourbon, 1929 (MNHN) [examined]. **Syn. n.**

Chrysopa (*Chrysoperla*) *pudica* (Navás); Tjeder, 1966: 397.

Chrysoperla pudica (Navás); Ohm & Hölzel, 1982: 160.

Chrysoperla nigricana (Navás); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 149) ♂, 8.5–12 mm; ♀, 11–13 mm. Head markings variable, unmarked or sometimes marked with red post-ocular spot; red spot on gena; some specimens with short, black lateral stripe on clypeus. Maxillary palps unmarked. Antennae as long as fore wing. Pronotum with median yellow longitudinal stripe; often with red spot in each corner or medio-lateral spot; prothoracic setae pale, long or short. Claw (Fig. 150) with large basal dilation, about two-thirds length of claw hook (1.57–1.76: 1; mean 1.7). Fore wing with black gradates; crossveins in basal half of wing black at each end; 3–6 inner gradates, 4–9 outer gradates; *im* short, not meeting 1st *Rs* crossvein or apex of *im* meets crossvein; costal setae short (0.6 mm), inclined towards wing apex.

GENITALIA♂ (Figs 152–156). Apodeme of tergite 9 short, not extending beyond callus cercus; callus narrow, ovate; 26–35 trichobothria; lip of sternite 8+9 broad rounded; sternite 8+9 with subapical ventral swelling. Spinellae numerous, 6–8 spines arranged on tubercle. Gonosetae numerous, evenly distributed on gonosaccus. Arcessus lacking dorsal striations; apical membrane short, rounded, abruptly curved, sometimes reflexed. Entoprocessus short, narrow. Lateral plates of gonarcus broadly reniform; gonarcus arch broad. Acumen of tignum long, narrow, swollen apically.

GENITALIA♀ (Figs 157–159). Callus cercus ovate; 37 trichobothria. Subgenitale heart-shaped with broad basal extension. Spermatheca with deep ventral impression; vela short; duct long.

REMARKS. Hölzel & Ohm (1991; 1992) identified a small *Chrysoperla* species from Mauritius as *Chrysoperla brevicollis* (Rambur). I have examined this material and it is the same as *C. pudica*. Unfortunately, the type of *brevicollis* is missing so the identity of this species must be gleaned from the original description. Rambur's (1842) description is brief and in my opinion it is impossible to say with certainty the genus, let alone the species, referred to in this description. One of the most characteristic features of the Mauritian *Chrysoperla* species is its black gradate crossveins. However, in Rambur's description the venation is said to be very pale yellowish green and no mention is made of dark veins. In view of this I think that it is preferable to treat *Hemerobius brevicollis* as *nomen dubium* rather than as a senior synonym of *Chrysoperla pudica*.

Hölzel & Ohm (1992) treat the populations of *pudica* in Mauritius and mainland Africa as dis-

tinct species. However, I was unable to find any consistent character to separate the two taxa. In general specimens of *pudica* from Mauritius (fore wing length 9.5–10.5 mm) are smaller than those from the mainland. However, the smallest specimen that I examined during this study was a male from Nigeria with a fore wing length of 8.5 mm.

Specimens of *pudica* can be distinguished by the pale maxillary palps, large basal dilation of the claw and dark gradates. Males possess tuberculate spinellae and lack dorsal striations on the arcessus. *C. pudica* has not been recorded from Madagascar (Hölzel & Ohm, 1992) but this may simply be due to under collecting rather than disjunct distribution. *C. mutata* McL. is close to *pudica* and the species have many characters in common. However, the basal dilation of *pudica* is considerably larger than *mutata*. In *mutata* the basal tooth is less than half the length of the claw hook but in *pudica* the basal tooth is two-thirds the length of the claw hook. Also the angle between the basal tooth and the claw hook is greater in *mutata* than *pudica*.

I was unable to trace the type of *Chrysopa incongrua* Navás but it seems likely that the species is synonymous with *pudica*. Navás (1914c) describes the species as close to *congrua* with a black stripe on the lateral clypeus and yellow palps, typical markings for West African specimens of *pudica*. Nevertheless, he does not mention any darkening of the gradate crossveins which casts doubt on this interpretation.

GEOGRAPHIC VARIATION. West African specimens are marked with a short black fleck laterally on the clypeus. Southern African specimens are marked with a red post-ocular spot between the eye and vertex.

DISTRIBUTION. Throughout Afrotropics.

MATERIAL EXAMINED (17 ♂, 16 ♀) Ascension I., Mozambique, Namibia, Nigeria, South Africa, St Helena, Senegal, Zambia, Zimbabwe.

Chrysoperla mutata (McLachlan)

(Figs 160–170)

Chrysopa mutata McLachlan, 1898: 167. Lectotype ♂, ALGERIA: Biskra, 30.iii.1895 (Eaton) [Lectotype designated by Kimmins, 1940: 447] (BMNH) [examined].

Chrysopa nepia Navás, 1911: 266. Holotype ♀, ALGERIA (MNHN) [examined]. **Syn. n.**

Chrysopa libera Navás, 1928: 463. LECTOTYPE ♂ [here designated], LIBYA: Cyrenaica, Oasis Giarabub, 16.iii.1927 (*Canfalonieri*) (MCSN) [examined]. **Syn. n.**

Chrysopa quettana Navás, 1931a: 83. Lectotype ♀, PAKISTAN: Baluchistan, Quetta, 21.v.1930 (MNHN) [Lectotype designated by Leraut, 1991: 79.] [examined]. [Synonymized with *carnea* by Aspöck *et al.*, 1980: 268.] **Syn. n.**

Chrysopa phaeocephala Navás, 1931b: 120. Holotype ♂, TUNISIA: Bou Medma (Dumont) (MNHN) [examined]. **Syn. n.**

Chrysopa grazianii Navás, 1932: 418. LECTOTYPE ♂ [here designated], LIBYA: Cufra, v.1931 (MCSN). [examined]. **Syn. n.**

Chrysopa expurgata Tjeder, 1949: 83. Holotype ♂, ISRAEL: Kinneret, -200m, 10.v.1936 (Palmoni) (PALMONI COLL., ISRAEL) [not examined]. [Synonymized by Aspöck *et al.*, 1980: 270.]

Chrysopa (Chrysoperla) expurgata Tjeder; Tjeder, 1966: 391.

Chrysopa (Chrysoperla) mutata McLachlan; Hölzel, 1967: 35.

Anisochrysa (Chrysoperla) mutata (McLachlan); Hölzel, 1970: 51.

Anisochrysa (Chrysoperla) concinna Hölzel, 1974: 44. Holotype ♂, Iran: Bandarabbas, 3–10.iv.1972 (Ressl) (ASPÖCK COLL.) [examined]. **Syn. n.**

Chrysoperla mutata (McLachlan); Canard & Laudeho, 1978: 71.

Chrysoperla concinna (Hölzel); Hölzel, 1980: 169.

Chrysoperla nepia (Navás); Brooks & Barnard, 1990: 271.

Chrysoperla phaeocephala (Navás); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 160) ♂, 9–10.5 mm; ♀, 9.5–12.5 mm. Head marked or unmarked on gena with faint red spot; short narrow black stripe on lateral clypeus. Maxillary palp unmarked. Antennae as long as fore wing. Pronotum marked with longitudinal median yellow band; sometimes with dorso-lateral median red/brown spot or greyish antero-lateral spot; prothoracic setae long or short, pale. Basal dilation of claw about half length of claw hook (1.71–2.64: 1; mean 2.29) (Fig. 161–163). Fore wing crossveins dark at each end, except marginal veins at wing margin unmarked; gradates black; tympanal organ often marked with black spot; costal setae short (0.6 mm), inclined towards wing apex; 1–5 inner gradates; 2–6 outer gradates; cell *im* variable in length.

GENITALIA♂ (Figs 164–167). Lip of sternite 8+9 small, rounded; sternite 8+9 with small subapical swelling. Apodeme of tergite 9 short, not extend-

ing beyond callus cercus; callus cercus narrow, ovate; 23–33 trichobothria. Spinellae numerous, each tubercle bearing 5–7 spines. Gonosetae numerous, about 25 in lateral group. Arcessus lacking dorsal striations; apical membrane long, bent ventrally at 45–90°, tip pointed. Entoprocessus narrow, crescentic. Gonarcus with lateral plate broad, reniform; arch broad. Acumen of tignum long, narrow or swollen apically.

GENITALIA♂ (Figs 168–170). Callus cercus rounded; 33 trichobothria. Subgenitale heart-shaped. Spermatheca with moderate ventral impression; vela short; duct long.

REMARKS. *C. mutata* is most similar to *pudica* but can be distinguished by the shape of the claw. In *mutata* the basal dilation of the claw is about half the claw hook length, the posterior margin is relatively straight and the angle between the basal tooth and the claw hook is relatively large whereas in *pudica* the basal dilation is more than half the claw hook length, the posterior margin is curved and the angle between the basal tooth and the claw hook is less than in *mutata*.

DISTRIBUTION. From north Africa through Arabia and the Middle East to Pakistan and northern India.

MATERIAL EXAMINED (26♂, 24♀) Algeria, Egypt, India (Punjab, Rajastan), Iran, Iraq, Kuwait, Mauritania, Saudi Arabia, Spain, Tunisia.

Chrysoperla nigrinervis sp. n.

(Figs 171–178)

Fore wing (Fig. 171) ♂, 9 mm; ♀, 10.5 mm. Head marked with red spot on gena; long, broad black stripe on lateral clypeus. Maxillary palps unmarked. Antennae slightly longer than fore wing. Pronotum marked with longitudinal median yellow band; greyish lateral stripe; prothoracic setae short, pale. Claw (Fig. 178) with very small basal dilation, less than one-quarter length of claw hook (5.8: 1). Fore wing costal setae short (0.6 mm), inclined towards wing apex; crossveins entirely black; longitudinal veins black adjacent to crossveins; tympanal organ marked with black spot; gradates black; 3–4 inner gradates, 5–6 outer gradates; cell *im* short not reaching 1st *Rs* crossvein or meets at apex. Abdominal tergites marked with large black spot on posterior margin.

GENITALIA♂ (Figs 172–174). Lip of sternite 8+9 small, rounded; sternite 8+9 with small subapical swelling. Apodeme of tergite 9 short, not extend-

ing beyond callus cercus; callus cercus narrow, ovate; 31–32 trichobothria. Spinellae numerous, each tubercle bearing 5–7 spines. Gonosetae numerous, about 20 in lateral group. Arcessus lacking dorsal striations; apical membrane long, bent ventrally at 45°, tip pointed. Entoprocess small, narrow, crescentic. Gonarcus with broad lateral reniform plate; arch broad. Acumen of tignum long, narrow, slightly swollen at apex.

GENITALIA♀ (Figs 175–177). Callus cercus ovate; 37 trichobothria. Subgenitale with long narrow basal extension. Spermatheca with moderate ventral impression; duct long; vela long.

REMARKS. The male genitalia of *nigrinervis* are apparently indistinguishable from *mutata* but there are sufficient external characters to regard specimens from the Canary Islands as a distinct species. *C. nigrinervis* can be distinguished from *mutata* and the closely related *pudica* by the more extensively blackened venation, head, prothoracic and abdominal markings together with the small basal dilation of the claw. In addition, in females of *nigrinervis* the subgenitale has a narrower basal lobe than specimens of *mutata* and *pudica* which have a heart-shaped subgenitale.

DISTRIBUTION. Canary Islands.

MATERIAL EXAMINED (2♂, 3♀) Holotype ♂, Canary Islands: Gran Canaria, Maspalomas, 14.viii.1966 (Guichard & Ward) (BMNH) Paratypes 1♂, same data as holotype; 3♀, same data as holotype, 17–28.vi.1966 (BMNH)

Chrysoperla exul (McLachlan)

(Figs 179–187)

Chrysopa exul McLachlan, 1869: 23. Holotype ♂, ST HELENA (Melliss) (BMNH) [examined].

Chrysopa wollastoni Navás, 1914a: 80. Holotype (apex of abdomen missing), ST HELENA, 1877 (Wollaston) (BMNH) [examined]. [Synonymized by Kimmins, 1940: 446].

Chrysoperla exul (McLachlan); Hölzel, 1989b: 176.

Fore wing (Fig. 179) ♂, 12–13 mm, ♀, 13–14.5 mm. Head marked with red spot on outer angle of frons; red lateral spot on clypeus; red spot on lateral vertex; red spot between base of antennae; scape with faint lateral red stripe; maxillary palps black dorsally. Antennae longer than fore wing. Pronotum marked with brown spot in each corner and red cento-median spot; median yellow longitudinal band; prothoracic

setae short, pale. Claw (Fig. 180) with large basal dilation, about two-thirds length of claw hook (1.74: 1). Fore wing quite broad (length: breadth = 2.7–3.0: 1); costal setae short (0.4–0.6 mm); venation entirely green; 6–8 inner gradates, 7–9 outer gradates; *im* variable in length.

GENITALIA♂ (Figs 181–184). Lip of sternite 8+9 short, broad; callus cercus broad ovate; 33 trichobothria; apodeme of tergite 9 branched, extending only a short way beyond callus cercus. Spinellae present, 6–7 spines on numerous small tubercles. Gonosetae numerous. Entoprocessus small, crescentic. Arcessus straight, extreme apex curved at 45°; lacking dorsal striations; apical membrane of arcessus long, narrow, truncate apically. Gonarcus with broad reniform lateral plate; arch narrow. Acumen of tignum long, narrow.

GENITALIA♀ (Figs 185–187). Callus cercus ovate; 38 trichobothria. Subgenitale with narrow basal extension. Spermatheca with shallow ventral impression; vela short; duct long.

REMARKS. *C. exul* may be distinguished from other species of *Chrysoperla* by the characteristic head and pronotal markings, in particular the brown spot in each corner of the pronotum and the red spots on the vertex and between the antennae.

The possession of synapomorphies in *exul* and *congrua* suggests a close relationship between these two species. In both these species the gonarcus arch is narrow and the spinellae are tuberculous.

DISTRIBUTION. St Helena.

MATERIAL EXAMINED (6♂, 4♀) St Helena.

Chrysoperla congrua (Walker)

(Figs 188–195)

Chrysopa congrua Walker, 1853: 238. Holotype (abdomen missing), WEST AFRICA (BMNH) [examined].

Chrysopa concolor Walker, 1853: 239. Holotype (abdomen missing), ZAIRE (BMNH) [examined]. [Synonymized by Tjeder, 1966: 392.]

Chrysopa otalatis Banks, 1910a: 102. Holotype ♀, AUSTRALIA: Queensland, Brisbane, vi.1904 (MCZ) [not available for examination]. **Syn. n.**

Chrysopa bequaerti Navás, 1912: 409. Lectotype ♂, ZAIRE: Kongolo, 9.ii.1911 (*Bequaert*) [lectotype designation by Tjeder, 1966: 393.] (MRAC) [examined]. [Synonymized by Esben-Petersen, 1928a: 218.]

Chrysopa lemoulti Lacroix, 1923: 119. Holotype ♂, NEW CALEDONIA (MNHN) [examined]. [Synonymized with *otalatis* by Esben-Petersen, 1928b: 103.] **Syn. n.**

Chrysopa clypealis Navás, 1929b: 103. Holotype ♀, ZAIRE: Haut-Uele, Yebo Moto, Abmiva, 1925 (*Burgeon*) (MRAC) [examined]. **Syn. n.**

Chrysopa solaris Navás, 1930: 411. Holotype ♂, EAST AFRICA: Marangu (ZMH) [destroyed]. [Synonymized by Hölzel, 1989b: 166.]

Chrysopa bequaerti var. *occipitalis* Navás, 1931c: 127. Holotype ♀, ZAIRE (MRAC) [examined]. **Syn. n.**

Chrysopa congrua var. *rubella* Navás, 1931c: 127. Holotype ♀, ZAIRE (MRAC) [examined]. **Syn. n.**

Chrysopa acutella Navás, 1933a: 209. Holotype ♂, MADAGASCAR: Majunga (MNHN) [examined]. [Synonymized by Hölzel, 1989b: 166.]

Chrysopa (Chrysoperla) congrua (Walker); Tjeder, 1966:392.

Chrysoperla congrua (Walker); Séméria & Quilici, 1986: 110.

Chrysoperla otalatis (Banks); Brooks & Barnard, 1990: 271.

Chrysoperla acutella (Navás); Brooks & Barnard, 1990: 271.

Chrysoperla clypealis (Navás); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 188) ♂ 10–12 mm; ♀ 12–13.5 mm. Head usually marked with red lateral stripe on gena, clypeus, sometimes extending to frons; red post-ocular spot often present. Maxillary palp unmarked or marked black dorsally. Antenna about as long as fore wing. Pronotum with longitudinal median yellow band and often with red or greyish spot in anterior corner; prothoracic setae long, pale (short in Easter I. specimens). Claw (Fig. 189) with small basal dilation, less than one quarter length of claw hook (4.1–6.25: 1; mean 5.05). Fore wing narrow (length: breadth = 3.0–4.2: 1), pointed apically; 5–8 inner gradates, 5–9 outer gradates; *im* very short; costal setae moderately long (0.8–1.0 mm), inclined; veins green except c1 and c2 crossveins maybe darkened; 1st *Rs* crossvein at right-angles to *Rs*.

GENITALIA♂ (Figs 190–192). Lip of sternite 8+9 short, narrow, downcurved. Callus cercus broad, ovate; 24–33 trichobothria; apodeme of tergite 9 extends beyond callus cercus. Spinellae sparse, 4–6 spines arranged on small tubercles. Gonose-tae numerous, evenly distributed across gonosac-

cus. Arcessus narrow, weakly curved, lacking dorsal striations, apex blunt and slightly swollen. Entoprocessus very small, short and narrow. Gonarcus with narrow arch and narrow, wedge-shaped lateral plates. Acumen of tignum short, bulbous.

GENITALIA♀ (Figs 193–195). Callus cercus rounded. Basal extension of subgenitale usually long and narrow. Spermatheca small with deep ventral impression; vela short; duct long.

REMARKS. *C. congrua* is characterized by possessing green gradates, a small basal dilation of the claw and narrow fore wings with a short intramedian cell. A close relationship between *congrua* and the Neotropical species of *Chrysoperla* is suggested by the synapomorphous possession of a swollen apex to the arcessus and bulbous acumen (cf. *C. externa*).

From New's (1980) description of *Chrysopa italotis* Banks, evidently based on the female holotype, it is apparent that the species is referable to *Plesiochrysa* (**comb. n.**). However, the figure he gives of the male genitalia are those of a *Chrysoperla* species. On examination of the eight specimens New (1980) identified as *C. italotis*, from the ANIC, it is apparent that in fact these are misidentified specimens of *Chrysoperla congrua*.

GEOGRAPHICAL VARIATION. Most material examined from Australia, New Caledonia and New Hebrides had the maxillary palps unmarked. In specimens from Samoa, Easter Island and West Malaysia the palps were always black dorsally. The palps were variable in specimens from other regions. All the Sri Lankan specimens were collected between 4,000 and 7,000 feet.

DISTRIBUTION. Throughout Australasia from the Pacific Islands to Sri Lanka (absent from India), throughout the Afrotropics and recorded from Oman on the Arabian Peninsular (Hölzel & Ohm, 1992)

MATERIAL EXAMINED (117♂, 196♀). Afrotropics: Angola, Botswana, Ethiopia, Fernando Po, Gabon, Ghana, Ivory Coast, Kenya, Madagascar, Malawi, Mozambique, Nigeria, Principi Island, Ruanda, South Africa, Tanzania, Uganda, Urundi, Zaire, Zambia, Zimbabwe. Oriental: Sri Lanka, Thailand, West Malaysia. Australasian: Australia, New Caledonia, New Hebrides, Papua New Guinea. Pacific: Easter I., Fiji, Rapa I., Samoa.

Chrysoperla dozieri (Smith)

(Figs 196–202)

Chrysopa dozieri Smith, 1931: 808. Holotype ♂, HAITI: Port au Prince, 29.ii.1929 (Smith) (MCZ) [examined].

Chrysoperla dozieri (Smith); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 196) ♂, 10.5–12 mm; ♀, not seen. Head marked with red L-shaped stripe across frontal suture; red stripe on gena and lateral clypeus; narrow medio-lateral red spot on front of vertex. Maxillary palps marked black dorsally. Antennae as long as fore wing. Pronotum marked with longitudinal median yellow band; medio-lateral black spot and usually with red stripe in anterior corner; prothoracic setae short, pale. Claw (Fig. 197) with large basal dilation, about half length of claw hook (2.08: 1). Fore wing pointed at apex; costal setae short (0.4–0.6 mm), inclined towards wing apex; 5–6 inner gradates, 6–8 outer gradates; gradates black; other crossveins black each end; cell *im* long, 1st *Rs* crossvein meets *im* at apex or sub-apically; 1st *Rs* crossvein straight or oblique.

GENITALIA♂ (Figs 198–202). Lip of sternite 8+9 broad, rounded. Apodeme of tergite 9 forked above and below callus, short; callus cercus broad, ovate; 29 trichobothria. Spinellae few, tuberculate. Gonosetae numerous, in lateral group. Arcessus broad, straight; dorsal striations absent; membranous tip spade-like (narrows sub-apically, then abruptly widens at apex), truncate at apex, curved ventrad at 90°. Entoprocessus not visible. Gonarcus lateral plates broadly triangular; arch broad. Acumen of tignum narrow, hardly swollen apically.

REMARKS. This species can be readily distinguished from other species in the genus by the presence of a pair of narrow red spots on the vertex. Some Cuban specimens of *exotera* may also have a pair of red spots on the front of the vertex but they are broader than those of *dozieri*. Unlike *dozieri*, specimens of *exotera* do not have a red stripe below the fronto-clypeal suture. The spade-like apex of the arcessus in the male genitalia is also distinctive. *C. dozieri* differs from other *Chrysoperla* species in the *rufilabris*-group in plesiomorphically retaining a broad gonarcus arch and a broad arcessus. The species also has fewer spinellae tubercles than other *rufilabris*-group species. *C. dozieri* is endemic to Haiti and this geographical isolation may account for its apparent phylogenetic isolation.

DISTRIBUTION. Haiti.

MATERIAL EXAMINED (2♂, 2 examples with abdomens missing) Haiti.

Chrysoperla defreitasi sp. n.

(Figs 203–208)

Fore wing ♂ (Fig. 203), 11 mm; ♀ unknown. Head marked with broad red stripe on gena, lateral clypeus and lateral labrum; narrow red stripe on lateral fronto-clypeal suture. Maxillary palps marked black dorsally. Pronotum with yellow longitudinal median stripe and narrow brownish red lateral stripe; prothoracic setae long, pale. Claw (Fig. 208) with large basal dilation, about two-thirds length of claw hook (1.68: 1). Fore wing relatively narrow (length: breadth = 3: 1); venation mostly green with black gradates, basal costal crossveins entirely black, black spot at each end of radial and *Rs* crossveins, *c*₁/*c*₂ crossvein entirely black; marginal branches of veins *Cu*₂, *1A* and *2A* entirely black; apex of fore wing pointed; costal setae short (0.6 mm), inclined towards wing apex; *im* short, not reaching 1st *Rs* crossvein; 5 inner gradates, 7 outer gradates.

GENITALIA♂ (Figs 204–207). Dorsal apodeme of tergite 9 long; callus cercus narrow ovate; 28–29 trichobothria; lip of sternite 8+9 short, broad. Spinellae present, 29 large tubercles with 7–8 spicules. Gonosetae numerous 50+ in lateral group. Arcessus broad, tapering subapically before widening to form spatulate apex; dorsal striations absent. Entoprocessus narrow, crescentic. Gonarcus with broad, wedge-shaped lateral plates; arch relatively broad, truncate medially with bilobed median projection. Acumen of tignum long, narrow, slightly swollen at apex.

REMARKS. *C. defreitasi* closely resembles *C. externa* and *C. exotera*. From *C. exotera*, *C. defreitasi* cannot be reliably distinguished on external characters although the claw hook is larger in *defreitasi* than in *exotera*. However, the male genitalia are quite different. In *C. defreitasi* the arcessus is broad with a spatulate apex whereas in *C. exotera* the arcessus is narrow and truncate at the apex.

C. defreitasi may be distinguished from *externa* by the black gradate crossveins, which are green in *externa*, and the basal dilation of the claw, which is considerably larger in *defreitasi* than *externa*. Certain apomorphic characters in the male genitalia suggest that *C. defreitasi* may be closely related to *C. dozieri*, from Haiti. In both

species the unstriated arcessus is broader than is typical in neotropical species of the genus, the apex of the arcessus is spatulate and the gonarcus arch is relatively broad. Although the entoprocessus are narrow in *C. defreitasi*, they are larger than other *Chrysoperla* species in species-group 4.2 (see p. 143).

DISTRIBUTION. Brazil.

MATERIAL EXAMINED (1♂) Holotype ♂, Brazil: Jaquaritingas, 15.xi.1992 (*de Freitas*) (USP).

Chrysoperla asoralis (Banks)

(Figs 209–217)

Chrysopa asoralis Banks, 1915: 627. Holotype ♂, PERU: Chosica, 2800', 7.vi. (*Parish*) (MCZ) [examined].

Chrysopa oscillans Navás, 1922a: 260. LECTOTYPE ♂ [here designated], PERU: Arequipa, 1912 (*Escomel*) (MNHN) [examined]. **Syn. n.**

Chrysopa lindana Navás, 1924b: 111. Holotype ♀, PERU: on the Chilean frontier, 1921 (*Martin*) (MNHN) [examined]. **Syn. n.**

Chrysopa arequipae Navás, 1929a: 18. Holotype ♀, PERU: Arequipa, 1922 (*Escomel*) (MNHN) [examined]. **Syn. n.**

Chrysoperla asoralis (Banks); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 209) ♂, 10–14 mm, ♀, 12–16 mm. Head marked with red stripe on gena, lateral clypeus and frons, occasionally with vertex red dorsally; red post-ocular spot. Maxillary palps black dorsally. Antennae as long as fore wing. Pronotum with median longitudinal yellow stripe; red spot in anterior corner; prothoracic setae short, pale. Claw (Fig. 210) with large basal dilation, over half length of claw hook (1.83–1.87: 1; mean 1.85). Fore wing pointed at apex; costal setae short (0.6–0.8 mm), inclined towards wing apex; cell *im* variable in length; 1st *Rs* crossvein meets *Rs* at right-angles; 5–8 inner gradates, 6–9 outer gradates; gradates black; other crossveins dark at each end, except *Psm* crossveins unmarked.

GENITALIA♂ (Figs 214–217). Lip of sternite 8+9 broad, rounded. Dorsal apodeme of tergite 9 long, extending well-beyond callus cercus; callus cercus narrow, ovate; 20–41 trichobothria. Spinellae numerous, each tubercle with 4–5 long spines. Gonosetae numerous, 50+ in lateral group. Arcessus narrow, arcuate, occasionally recurved apically; dorsal striations absent; apical membrane long, pointed at tip. Entoprocessus minute, slender, crescentic. Gonarcus arch nar-

row; narrow wedge-like lateral plate. Acumen of tignum long, swollen at apex.

GENITALIA♀ (Figs 211–213). Callus cercus rounded; 32 trichobothria. Subgenitale with narrow basal extension. Spermatheca small with moderate ventral impression; vela moderate; duct long.

REMARKS. *C. asoralis* most closely resembles *exotera* and *rufilabris*, both of which have black gradate crossveins and black maxillary palps. From *exotera*, *asoralis* can be distinguished by the red post-ocular spot, which is absent in *exotera*, and the apical membrane of the arcessus which is pointed at the tip in males of *asoralis* but truncate and slightly swollen in males of *exotera*. *C. rufilabris* also differs from *asoralis* in the shape of the apex of the arcessus which is much longer and is abruptly narrowed in the former species. In addition, the acumen is shorter and broader in *rufilabris* than *asoralis*. The spinellae are unusually long in *asoralis*.

The type of *lindana* differs from other specimens of *asoralis* in having a longer fore wing (16 mm, which was 2 mm longer than the next largest specimen) and the vertex marked red with a narrow median interruption. However, I consider these differences to be due to individual variation and not of taxonomic significance.

DISTRIBUTION. Neotropics.

MATERIAL EXAMINED (20♂, 14♀) Argentina, Bermuda, Guatemala, Peru, Venezuela.

Chrysoperla exotera (Navás)

(Figs 218–226)

Chrysopa exotera Navás, 1914a: 87. Holotype ♀, GUATEMALA: Duenas, Capetillo (*Champion*) (BMNH) [examined].

Chrysopa extranea Navás, 1922b: 170. Holotype ♂, CUBA (MCZ) [examined]. **Syn. n.**

Chrysopa estradai Navás, 1924a: 334. Holotype, CUBA: Habana, Rio Almendares, 23–26.x.1923 (*Cervera*) (HAVANA) [not examined]. **Syn. n.**

Chrysopa torrei Navás, 1924a: 335. Holotype ♂, CUBA: Habana, Rio Almendares, 8.ix.1923 (*Cervera*) (MCZ) [examined]. **Syn. n.**

Chrysopa barbouri Navás, 1924a: 335. Holotype sex unknown (abdomen missing), CUBA: Habana, Rio Almendares, 8.xii.1923 (*Cervera*) (MCZ) [examined]. **Syn. n.**

Chrysopa tenera Navás, 1924a: 336. Holotype ♀, CUBA: Habana, Rio Almendares, 8.xii.1923 (MCZ) [examined]. **Syn. n.**

Chrysopa exterior Navás, 1925: 190. [Replacement name for *C. extranea* Navás].

Chrysopa cubensis Navás, 1927a: 75. [Unnecessary replacement name for *C. extranea* Navás].

Chrysopa incisa Banks, 1948: 163. Holotype ♀, MEXICO: Chihuahua, Ciudad Juárez, 4.vi.1927 (*Dampf*) (MCZ) [not examined, not traced in MCZ]. **Syn. n.**

Chrysopa quadornia Banks, 1948: 164. Holotype ♀, MEXICO: Acapulco, 19.xii.1924 (*Dampf*) (MCZ) [not examined, not traced in MCZ]. **Syn. n.**

Chrysopa castalia Banks, 1948: 165. Holotype ♀, MEXICO: Tamaulipas, Santa Engracia, 3.ii.1936 (*Dampf*) (MCZ) [not examined, not traced in MCZ]. **Syn. n.**

Chrysoperla exotera (Navás); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 218) ♂, 13 mm; ♀, 11.5–13.5 mm. Head marked with red spot on gena, lateral clypeus and lateral frons; anterior margin of vertex sometimes with red stripe or paired spots; entire head occasionally suffused red. Maxillary palps black dorsally. Antennae shorter than fore wing. Yellow longitudinal band on pronotum present or absent; occasionally with red spot in anterior corner; prothoracic setae long, pale. Claw (Fig. 219) with large basal dilation, about half claw hook length (2.07: 1). Fore wing apex pointed; costal setae short (0.6–0.8 mm), inclined towards wing apex; gradates black or greyish; crossveins black at each end except at wing margins; 5–7 inner gradates, 7–9 outer gradates; cell *im* short, apex not reaching 1st *Rs* crossvein; 1st *Rs* crossvein straight or oblique.

GENITALIA♂ (Figs 220–223). Lip of sternite 8+9 broad, rounded. Dorsal apodeme of tergite 9 short, forked above or below callus cercus; callus cercus broad, ovate; 40 trichobothria. Spinellae numerous, about 8 spines on each tubercle. Gonosetae numerous, arranged in lateral group. Arcessus narrow, arcuate; dorsal striations absent; apical membrane short, tip broadened, truncate. Entoprocessus minute, narrow, crescentic. Gonarcus with lateral plates narrow, reniform or wedge-shaped; arch narrow. Acumen of tignum short, broad, swollen at apex.

GENITALIA♀ (Figs 224–226). Callus cercus rounded; 32 trichobothria. Subgenitale with narrow basal extension. Spermatheca narrow with deep ventral impression; vela long; duct moderate.

REMARKS. This species is very similar to

comanche but can be distinguished by the black gradate crossveins which are green in *comanche*. In addition, the apex of the arcessus and acumen in *exotera* is swollen, whereas in *comanche* they are narrow.

DISTRIBUTION. Central America and Cuba.

MATERIAL EXAMINED (1♂, 4♀) Cuba, Costa Rica, Guatemala, Mexico.

Chrysoperla externa (Hagen)

(Figs 227–236)

Chrysopa externa Hagen, 1861: 221. Syntypes, USA: Washington, California; Mexico (MCZ) [not traced].

Chrysopa lanata Banks, 1910b: 154. Holotype ♂, ARGENTINA: Mendoza (*Jensen-Haarup*) (MCZ) [examined]. [Synonymized by Adams, 1962: 222.]

Chrysopa graciana Navás, 1919: 301. Holotype, ARGENTINA: Alta Gracia, ii.1918 (*Bruch*) (LP) [not examined]. [Synonymized with *argentina* Navás by Adams, 1975: 169. Synonymized with *externa* by Adams & Penny, 1987: 421.]

Chrysoperla externa (Hagen); Adams, 1983: 43.

Chrysoperla externa cocosensis Adams, 1983: 42. Holotype ♂, COSTA RICA: Cocos I., Wafer Bay, 9.iii.1980 (*Sherry & Werner*) (LACM) [examined]. **Syn. n.**

Fore wing (Fig. 227) ♂, 10.5–11.5 mm; ♀, 12.5 mm. Head marked with broad red stripe on gena and lateral clypeus; red post-ocular stripe. Maxillary palps black dorsally. Antennae about same length as fore wing. Pronotum with yellow longitudinal median band; usually with reddish spot in anterior corner; prothoracic setae long or short, pale or black. Claw (Fig. 228–229) with small basal dilation, less than half claw hook length (2.4–2.54: 1; mean 2.48). Fore wing narrow (length: breadth = 3.1–3.5: 1), apex pointed; costal setae short (0.6–1.0 mm), inclined towards wing apex; 5–7 inner gradates, 6–8 outer gradates; gradates green; crossveins in basal half of wing often darkened at each end; cell *im* very short, not reaching 1st *Rs* crossvein; 1st *Rs* crossvein meets *Rs* at right angles.

GENITALIA♂ (Figs 230–233). Lip of sternite 8+9 rounded. Dorsal apodeme of tergite 9 long, forked below callus; callus cercus narrow, ovate; 28–32 trichobothria. Spinellae numerous, each tubercle with 5–6 spines. Gonosetae numerous, positioned centrally on gonosaccus. Arcessus without dorsal striations; membranous apex of

arcessus short, bulbous, curved ventrally at 45°. Entoprocessus small triangular, often not visible. Gonarcus with lateral plates narrow, wedge-shaped; arch narrow. Acumen of tignum long, slightly swollen apically.

GENITALIA♀ (Figs 234–236). Callus cercus ovate; 32 trichobothria. Subgenitale with broad, rounded basal extension. Spermatheca narrow; ventral impression deep; vela short; duct long.

REMARKS. *C. externa* is similar in appearance to *comanche* but the basal dilation of the claw is smaller in *externa* and the apex of the arcessus is narrow in *comanche* but swollen in *externa*. *C. externa* appears to be closely related to *congrua*, since the male genitalia are very similar and the apex of the arcessus is swollen in both species. However, although the apex of the acumen is swollen in both *externa* and *congrua*, the neck is longer in *externa*. In addition the basal dilation of the claw is noticeably larger in *externa* than *congrua*.

I have examined a female specimen deposited in the MCZ which has been identified as *C. externa* Hagen by Banks (USA: Florida, Winter Park, 31.x., Davis). This specimen bears a purple label, type written 'neotype'. I have not been able to trace any reference to this specimen being nominated a neotype so this designation has no validity. The specimen has been correctly identified but since there is no confusion regarding the identity of *C. externa* and considering that the specimen was not collected in the same region as the original type series I see no merit in formally recognising this specimen as a neotype.

Adams (1983) distinguished *C. e. cocosensis* from *C. e. externa* on the basis of the arcessus being sclerotised medially in the former taxon but sclerotised laterally with a median membranous area in the latter. However, examination of the holotype of *C. e. cocosensis* revealed that Adams had misinterpreted the structure of the arcessus and that, in fact, the lateral sclerotised strips are separated by a membranous median area. The arcessus of other males examined from Cocos Island were also indistinguishable from typical examples of *C. externa*.

GEOGRAPHICAL VARIATION. In Mexican specimens the post-ocular spot is absent, the lateral frons marked with red stripe, the basal dilation of the claw larger and the intramedian cell longer than typical specimens.

DISTRIBUTION. Throughout Neotropics, extending northwards to Florida and South Carolina (Adams, 1962).

MATERIAL EXAMINED (27♂, 48♀) Argentina, Belize, Brazil, Costa Rica (Cocos Island), Guatemala, Mexico, Peru, Uruguay, USA (Florida), Venezuela, West Indies (Bahamas, Barbados, Cayman, Trinidad).

Chrysoperla galapagoensis (Banks)

(Figs 237–245)

Chrysopa galapagoensis Banks, 1924: 179. Holotype, ECUADOR: Galapagos Is, South Seymour, 23.iv.1923 (Beebe) (MCZ) [not examined].

Chrysoperla galapagoensis (Banks); Brooks & Barnard, 1990: 271.

Fore wing (Fig. 237) ♂, 9–10.5 mm; ♀, 10.5 mm. Head marked with black stripe on gena and lateral clypeus; red stripe on lateral frons, lateral labrum and dorso-lateral clypeus; red post-ocular stripe present or absent. Maxillary palps black dorsally. Antennae shorter than fore wing. Pronotum usually marked with narrow black median stripe and latero-median black spot, yellow longitudinal stripe absent; prothoracic setae long, black or pale. Claw (Fig. 238) with small basal dilation, less than half length of claw hook (2.73: 1). Fore wing pointed apically; costal setae short (0.6–0.8), inclined towards wing apex; 4–6 inner gradates, 5–6 outer gradates; gradates black; crossveins entirely black, except *Psc* crossveins in apical half of wing; cell *im* short, not quite meeting 1st *Rs* crossvein or crossvein meets apex of cell; 1st *Rs* crossvein oblique or at right-angles to *Rs*.

GENITALIA♂ (Figs 239–241). Lip of sternite 8+9 narrow, rounded. Apodeme of tergite 9 short, branched below callus cercus; callus cercus narrow, ovate; 23–26 trichobothria. Spinellae few, 6–12 small tubercles bearing about 4 spines. Gonosetae numerous. Arcessus narrow, gently curved; lacking dorsal striations; apex rounded and slightly expanded. Entoprocessus not visible. Gonarcus with lateral plates narrow, wedge-shaped; arch narrow. Acumen of tignum short, slightly swollen apically.

GENITALIA♀ (Figs 242–245). Callus cercus broadly ovate; 28 trichobothria. Subgenitale with short, narrow basal extension. Spermatheca with shallow ventral impression; vela short; duct short.

REMARKS. *C. galapagoensis* is distinctive amongst *Chrysoperla* species because of the extensive black venation, prominent black lateral stripe on the head and narrow black median

stripe on the pronotum. The male genitalia are also distinctive since the spinellae are few and small. The arcessus is slightly swollen apically which is reminiscent of *externa* but the tip of the arcessus is more bulbous in *externa* than *galapagoensis*.

DISTRIBUTION. Galapagos Islands.

MATERIAL EXAMINED (5♂, 5♀) Galapagos Islands (Fernandina, Hood, Indefatigable, Jervis, Santiago, South Seymour, Tower).

Chrysoperla comanche (Banks)

(Figs 246–255)

Chrysopa comanche Banks, 1938: 119. Holotype ♀, USA: Texas, Laredo (MCZ) [examined].

Chrysopa sperryae Banks, 1943: 74. Holotype ♀, USA: California, Riverside (*Sperry*) (MCZ) [not examined]. [Synonymized by Adams, 1956: 45.]

Chrysoperla comanche (Banks); Garland, 1985b: 738.

Fore wing (Fig. 246) ♂, 8–11 mm; ♀, 12–12.5 mm. Head marked with red stripe on gena and lateral clypeus, usually extending to lateral frons; red post-ocular spot present or absent; occasionally head totally unmarked. Maxillary palps black dorsally. Antennae about as long as fore wing. Pronotum with yellow longitudinal median stripe; sometimes with dorso-median black spot. Claw (Fig. 247) with large basal dilation, over half length of claw hook (1.86–2.0: 1; mean 1.93). Fore wing apex pointed; costal setae short (0.4–0.6 mm), inclined towards wing apex; *Rs* crossveins in stigmatic region sinuate; 3–6 inner gradates, 4–8 outer gradates; gradates green, sometimes inner gradates greyish; crossveins in basal half of wing sometimes dark at ends; cell *im* short, not reaching 1st *Rs* crossvein; 1st *Rs* crossvein oblique or at right-angles to *Rs*.

GENITALIA♂ (Figs 248–252). Lip of sternite 8+9 broad, rounded. Apodeme of tergite 9 long, forked below callus; callus cercus narrow, ovate; 26–29 trichobothria. Spinellae numerous, 4–5 long spines on tubercle. Gonosetae numerous, 50+ in lateral group. Arcessus narrow, arcuate; dorsal striations absent; apical membrane short, truncate or slightly broadening. Entoprocessus minute, slender crescentic. Gonarcus with narrow lateral plates; arch narrow. Tignum with acumen long, slightly widened apically.

GENITALIA♀ (Figs 253–255). Callus cercus rounded; 30 trichobothria. Subgenitale with

long, narrow basal extension. Spermatheca with moderate ventral impression; duct short; vela moderate.

REMARKS. *C. comanche* is very similar to *exotera* but there are two characters that suggest they are distinct species. Specimens assignable to *exotera* have black gradate crossveins, swollen acumen and the arcessus is markedly swollen at the extreme apex. In *comanche* the gradates are green, the acumen is narrow and the apex of the arcessus is narrow or slightly widened. The two species are also separated geographically, with *exotera* occurring in Central America but *comanche* being restricted to southwest USA. *C. comanche* can be distinguished from most New World *Chrysoperla* species by the green gradates. From the *carnea*-group of species *comanche* can be separated by the red stripe on the gena since the gena is marked brown in the *carnea*-group. From *externa*, *comanche* differs by having a large basal dilation of the claw, and narrow arcessus. In *externa* the basal dilation of the claw is distinctly less the half the length of the claw hook and the arcessus is swollen apically.

Material examined from the Hawaiian Islands had been previously identified as *C. lanata* Banks (Zimmerman, 1957), which is now considered as a synonym of *C. externa* (Hagen) (Adams, 1962). However, all Hawaiian specimens examined in this study proved to be *comanche* and there is no evidence that *externa* occurs on the Hawaiian Islands.

DISTRIBUTION. South-west USA, Hawaii.

MATERIAL EXAMINED (51♂, 48♀). USA (Arizona, California); Hawaiian Islands (Kauai, Lanai, Maui, Molokai, Oahu).

Chrysoperla harrisii (Fitch)

(Figs 256–265)

Chrysopa perla Harris, 1841: 197. Holotype, USA: New England (MCZ) [not examined]. [Homonym of *Chrysopa perla* L.]

Chrysopa harrisii Fitch, 1855: 794. [New name for *C. perla* Harris].

Chrysopa stenostigma Navás, 1914b: 61. Holotype (sex unknown), USA: New York, Long Island, Yaphank, 25.vii.1913 (NAVAS COLL.) [not traced]. [Synonymized by Bickley & MacLeod, 1956: 193.]

Chrysoperla harrisii (Fitch); Garland, 1985a: 93.

Fore wing (Fig. 256) ♂, 12.5 mm; ♀, 13–14 mm. Head marked with broad red stripe on gena, lateral frons and lateral clypeus; broad red post-

ocular stripe. Maxillary palps black dorsally. Antennae slightly longer than fore wing. Pronotum marked with yellow longitudinal median band; brownish spot in anterior corner; prothoracic setae short, black or pale; setal follicles black. Claw (Fig. 257) with very small basal dilation, less than one-quarter claw hook length (8: 1). Fore wing narrow (length: breadth = 3.2–3.4: 1), apex pointed; venation entirely green; costal setae short (0.8–1.0 mm), inclined towards wing apex; cell *im* long, 1st *Rs* crossvein meets *im* at apex or subapically; 1st *Rs* crossveins leaves *Rs* obliquely; 7–9 inner gradates, 9–10 outer gradates.

GENITALIA♂ (Figs 258–262). Lip of sternite 8+9 broad, rounded. Dorsal apodeme of tergite 9 long, extending far beyond callus cercus; callus cercus narrow, ovate; 32 trichobothria. Spinellae present, numerous tubercles bearing about 7 spines. Gonosetae numerous, arranged in lateral group. Arcessus without dorsal striations; strongly curved ventrad; membranous tip bent at 90°, truncate apically. Entoprocessus minute, crescentic. Lateral plate of gonarcus narrow wedge-shaped; arch narrow. Acumen of tignum short, broad, slightly swollen apically.

GENITALIA♀ (Figs 263–265). Callus cercus broadly ovate; 37 trichobothria. Subgenitale with long, narrow basal extension. Spermatheca with shallow ventral impression; vela short; duct short.

REMARKS. *C. harrisii* is one of the narrow winged species of *Chrysoperla* but is characterized by the entirely green venation and extremely small basal dilation of the claw. The male genitalia of *harrisii* are similar to those of *comanche* which suggests that the two species may be closely related. However, these species may be differentiated by the head markings, which are more extensive in *harrisii* than *comanche* and the shape of the acumen, which is broader in *harrisii* than *comanche*.

DISTRIBUTION. Canada (Garland, 1982); USA: California, Maryland, Michigan, Virginia (Bram & Bickley, 1963); Montana, Connecticut; Mexico.

MATERIAL EXAMINED (2♂, 3♀). USA: Montana; Connecticut.

Chrysoperla mexicana sp. n.

(Figs 266–274)

Fore wing (Fig. 266) ♂, 10.5 mm; ♀, 11.5 mm. Head marked with broad red lateral stripe on

gena, frons and clypeus with blackish flecks on gena and clypeus. Maxillary palp black dorsally. Antennae about same length as fore wing; outer margin of scape with apical brown stripe; pedicel and flagellar segments entirely dark brown. Pronotum marked with yellow median longitudinal band and brownish red lateral stripe; prothoracic setae short, black. Claw (Fig. 267) undilated basally. Fore wing narrow (length: breadth = 3.4–3.6: 1), apex pointed; gradate crossveins green; costal, radial and *Psc* crossveins black, darker in basal half of wing; veins 1A, 2A, *Cu*₂, base of *Rs* and *Psm* at cell *M*₂ and *im* all black; other veins green; costal setae short (0.6 mm), inclined towards wing apex; cell *im* short, 1st *Rs* meets *Psm* just beyond apex of *im*; 1st *Rs* crossvein leaves *Rs* at right angles; 5–6 inner gradates, 7–8 outer gradates.

GENITALIA♂ (Figs 268–271). Lip of sternite 8+9 broad, rounded. Dorsal apodeme of tergite 9 short, not extending beyond callus cercus. Callus cercus broad, ovate; 29 trichobothria. Spinellae present, numerous tubercles with 5–7 spines. Gonosetae numerous, arranged in lateral group. Arcessus narrow, without dorsal striations; apex curved ventrally at 90°; apical membrane moderately long, truncate at tip. Entoprocessus very narrow, crescentic. Lateral plate of gonarcus narrow, quadrangular; arch narrow. Acumen of tignum narrow, swollen at apex.

GENITALIA♀ (Figs 272–274). Callus cercus broad, ovate; 26 trichobothria. Subgenitale with long narrow basal lobe. Spermatheca with shallow ventral impression (everted in figure); vela short; duct short.

REMARKS. *Chrysoperla mexicana* can be readily distinguished by the black antennae, in all other species of the genus the antennae are green. Other distinguishing characters are the broad brownish lateral stripe on the pronotum, the undilated base of the claw and the narrow fore wings with dark venation in the basal half of the wing.

C. mexicana appears to be closely related to *harrisii* since both species share a number of apomorphies including narrow fore wings, claws with small basal dilation, truncate apex of arcessus, and long basal lobe on the spermatheca.

I am most grateful to Prof. P.A. Adams for drawing my attention to this species.

DISTRIBUTION. Mexico.

MATERIAL EXAMINED (1♂, 1♀) Holotype ♀, Mexico: Sinaloa, 36.6 miles NE Villa Union,

near La Capilla Detaxte, 2.vii.1982 (SDNHM)
Paratype ♀, same data as holotype.

***Chrysoperla rufilabris* (Burmeister)**

(Figs 275–285)

Chrysopa rufilabris Burmeister, 1839: 979. Syn-
types, Mid-USA & MEXICO (ZMH) [type
destroyed].

Chrysopa interrupta Schneider, 1851: 76. Holo-
type ♂, USA: Pennsylvania (NMHU) [not
examined]. [Synonymized by Bram & Bickley,
1963: 6.]

Chrysopa attenuata Walker, 1853: 242. Lectotype
♂, USA: Florida, St John's Bluff (*Doubleday*)
[Lectotype designation by Kimmins, 1940:
447.] (BMNH) [examined]. [Synonymized by
Banks, 1903: 161.]

Chrysopa repleta Walker, 1853: 244. Holotype
(abdomen missing), USA: Georgia (BMNH)
[examined]. [Synonymized by Banks, 1903:
161.]

Chrysopa novaeboracensis Fitch, 1855: 90. Syn-
types, USA: New York State (MCZ) [not
examined]. [Synonymized by Hagen, 1866:
395.]

Chrysopa tabida Fitch, 1855: 92. USA (MCZ)
[not examined]. [Synonymized by Hagen,
1866: 398].

Chrysopa citri Ashmead, 1880: 13. Holotype,
USA: Florida [not examined]. [Synonymized
by Bickley & MacLeod, 1956: 194.]

Chrysopa medialis Banks, 1903: 154. Holotype
♀, USA: Maryland, Colombia, High Is., ix
(MCZ) [not examined, not traced in MCZ].
[Synonymized by Bram & Bickley, 1963: 6.]

Chrysoperla rufilabris (Burmeister); Garland,
1985a: 93.

Fore wing (Fig. 275) ♂, 11–12 mm; ♀, 11.5–12.5 mm. Head marked with broad red stripe on gena, lateral clypeus and lateral frons; red post-ocular spot usually present; anterior margin of vertex sometimes marked with red stripe, which may extend between antennae. Maxillary palp black dorsally. Antenna slightly longer than fore wing. Pronotum marked with yellow longitudinal median stripe; often with red spot in anterior corner; prothoracic setae short, pale. Claw (Fig. 276–278) with large basal dilation, over half length of claw hook (1.85–2.23: 1; mean 2.02). Fore wing relatively narrow (length: breadth = 3.1–3.3: 1), apex pointed; costal setae moderately long (0.8–1.2 mm), inclined towards wing apex; 5–7 inner gradates, 6–8 outer gradates; gradates black; crossveins black at each end, except costal crossveins at costa and *Psc*

crossveins entirely green; cell *im* long, 1st *Rs* crossvein meets *im* subapically or at apex; 1st *Rs* crossvein meets *Rs* obliquely or at right angles. Abdomen green with yellow median longitudinal stripe on tergites and dorso-lateral red spot on tergites 1 and 2; in some specimens (possibly showing winter colouration) abdomen dark brown dorsally, posterior corner of tergite blackish brown, pale brown ventrally.

GENITALIA♂ (Figs 279–282). Lip of sternite 8+9 broad, rounded; with subapical patch of microsetae. Dorsal apodeme of tergite 9 short, extending a little beyond callus cercus; callus cercus narrow, ovate; 24–32 trichobothria. Spinellae present, numerous small tubercles bearing 6–7 spines. Gonosetae numerous, arranged in lateral group. Arcessus narrow; dorsal striations absent; apical membrane long, narrow, pointed at tip, curved ventrad at 90°; 3–4 mid-lateral microsetae present or absent. Entoprocessus minute or not visible, narrow crescentic. Gonarcus with lateral plates narrow, wedge-shaped; arch narrow. Acumen of tignum short, broad, rounded apically.

GENITALIA♀ (Figs 283–285). Callus cercus rounded; 27 trichobothria. Subgenitale with long, narrow basal extension. Ventral impression of spermatheca variable, shallow or deep; vela long; duct long.

REMARKS. The black gradate crossveins will serve to distinguish *C. rufilabris* from all other North American *Chrysoperla* species except some specimens of *C. johnsoni* and *C. downsi*. However, spinellae are absent in the male genitalia of *C. johnsoni* and the gena is often marked with a brown stripe. In *C. rufilabris* spinellae are present in the male genitalia and the gena is invariably marked red. The long, narrow membranous apex of the arcessus in males of *rufilabris* is unique within the genus.

GEOGRAPHIC VARIATION. Male specimens from Bermuda, Florida, Louisiana, South Carolina, Texas and Mexico were found to have 3–4 short setae situated laterally, mid-way along the arcessus. The setae were absent in males examined from Canada, Florida, Georgia, North Carolina, Oklahoma, Virginia. Up to 11 such setae were also reported by Bram & Bickley (1963) in 82% of specimens examined from Louisiana and 15% from Maryland, and in specimens from Kansas, Texas and Florida. Garland (1982) did not find any Canadian specimens with the setae. I was unable to find any secondary characters that conclusively correlated with the presence of the setae but the majority of the those specimens

that possessed setae on the arcessus also had long costal setae and the first *Rs* crossvein oblique. The possession of setae on the arcessus is unusual in Chrysopidae (Brooks & Barnard, 1990) and would be expected to be of taxonomic significance. However, Bram & Bickley (1963) found that of 12 males reared from a single female, one had setae on the arcessus and the other 11 specimens had none which suggests this may be simply a case of intraspecific variation.

DISTRIBUTION. Canada, Mexico, USA.

MATERIAL EXAMINED (41♂, 76♀) Bermuda, Canada, Mexico, USA: Arkansas, Florida, Georgia, Louisiana, Massachusetts, Mississippi, New York, North Carolina, Oklahoma, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Virginia.

SYNOPTIC CHECKLIST OF THE SPECIES OF *CHRYSOPELRA* STEINMANN

(* denotes types examined)

adamsi Henry, Wells & Pupedis, 1993 [Nearctic]

**annae* sp. n. [Eastern Palaearctic]

**asoralis* (Banks, 1915) [Neotropics]

**oscillans* (Navás, 1922) syn. n.

**lindana* (Navás, 1924) syn. n.

**arequipae* (Navás, 1929) syn. n.

**carnea* (Stephens, 1836) [Palaearctic]

**affinis* (Stephens, 1836)

microcephala (Brauer, 1850)

vulgaris (Schneider, 1851)

lamproptera (Stein, 1863)

**lucasina* (Lacroix, 1912) syn. n.

angeluina (Navás, 1931)

ferganica (Navás, 1933)

**pictavica* (Lacroix, 1933)

adaptata (Navás, 1934) syn. n.

lundbladi (Tjeder, 1939)

maderensis (Tjeder, 1939) syn. n.

canariensis (Tjeder, 1939)

**shansiensis* (Kuwayama, 1962) syn. n.

nanceiensis Séméria, 1980 syn. n.

**comanche* (Banks, 1938) [Nearctic]

sperryae (Banks, 1943)

comans (Tjeder, 1966) [Afrotropics]

**manselli* Hölzel, 1989 syn. n.

**congrua* (Walker, 1853) [Old World tropics]

**concolor* (Walker, 1853)

otalatis (Banks, 1910) syn. n.

**bequaerti* (Navás, 1912)

**lemoulti* (Lacroix, 1923) syn. n.

**clypealis* (Navás, 1929) syn. n.

solaria (Navás, 1930)

**acutella* (Navás, 1933)

**decaryana* (Navás, 1934) [Afrotropics]

**defretasi* sp. n. [Neotropics]

downesi (Smith, 1932) [Nearctic]

mohave (Banks, 1938) syn. n.

**dozieri* (Smith, 1931) [Haiti]

**exotera* (Navás, 1914) [Neotropics]

**extranea* (Navás, 1922) syn. n.

estradae (Navás, 1924) syn. n.

**torrei* (Navás, 1924) syn. n.

**barbouri* (Navás, 1924) syn. n.

**tenera* (Navás, 1924) syn. n.

exterior (Navás, 1925)

cubensis (Navás, 1927)

incisa (Banks, 1948) syn. n.

quadornia (Banks, 1948) syn. n.

castalia (Banks, 1948) syn. n.

**externa* (Hagen, 1861) [Neotropics]

**lanata* (Banks, 1910)

graciana (Navás, 1919)

**externa cocosensis* Adams, 1983 syn. n.

**exul* (McLachlan, 1869) [St Helena]

**wollastoni* (Navás, 1914)

**furcifera* (Okamoto, 1914) [Eastern Palaearctic]

savioi (Navás, 1933) syn. n.

**kulingensis* (Navás, 1936) syn. n.

galapagoensis (Banks, 1924) [Galapagos Is]

**gallagheri* Hölzel, 1989 [Oman]

harrisii (Fitch, 1855) [Nearctic]

stenostigma (Navás, 1914)

**insulata* (Fraser, 1957) [Mascarene Is]

**iranica* (Hölzel, 1967) [Iran]

johnsoni Henry, Wells & Pupedis 1993 [Nearctic]

mediterranea (Hölzel, 1972) [Western Palaearctic]

**mexicana* sp. n. [Mexico]

**mutata* (McLachlan, 1898) [Western Palaearctic]

**nepia* (Navás, 1911) syn. n.

**libera* (Navás, 1928) syn. n.

**quettana* (Navás, 1931) syn. n.

**phaeocephala* (Navás, 1931) syn. n.

**grazianii* (Navás, 1932) syn. n.

expurgata (Tjeder, 1949)

**concinna* (Hölzel, 1973) syn. n.

**nigrinervis* sp. n. [Canary Is.]

**nipponensis* (Okamoto, 1914) stat. rev. [Eastern Palaearctic]

kurisakiana (Okamoto, 1914)

**ilota* (Banks, 1915) syn. n.

- **kolthoffi* (Navás, 1927) **syn. n.**
 sinica* (Tjeder, 1936) **syn. n.
- **nyerina* (Navás, 1933) [Afrotropics]
 socia* (Navás, 1936) **syn. n.
- **oblita* Hölzel, 1973 [Eastern Palaearctic]
 **plicata* (Tjeder, 1966) [Afrotropics]
- plorabunda* (Fitch, 1855) [Nearctic]
robertsonii (Fitch, 1855)
pseudographa (Fitch, 1855)
illinoiensis (Shimer, 1865)
californica (Coquillett, 1890) **syn. n.**
- **pudica* (Navás, 1914) [Afrotropics]
incongrua (Navás, 1914) provisional **syn.**
 nigriciana* (Navás, 1931) **syn. n.
- **renoni* (Lacroix, 1933) [Western Palaearctic]
 ankylopteryformis* Monserrat & Diaz-Aranda, 1989 **syn. n.
- rufilabris* (Burmeister, 1839) [Nearctic]
interrupta (Schneider, 1851)
 **attenuata* (Walker, 1853)
 **repleta* (Walker, 1853)
novaeboracensis (Fitch, 1855)
tabida (Fitch, 1855)
citri (Ashmead, 1880)
medialis (Banks, 1903)
- **siamensis* **sp. n.** [Thailand]
- **sillemi* (Esben-Petersen, 1935) **stat. rev.** [Eastern Palaearctic]
punensis (Ghosh, 1976) **syn. n.**
gujaratensis (Ghosh, 1976) **syn. n.**
sanandensis (Ghosh, 1977) **syn. n.**
- zastrowi* (Esben-Petersen, 1928) [Afrotropics]
- NOT EXAMINED
- bellatula* Yang & Yang, 1992 (BAU)
chusanina (Navás, 1933) (ACAD SIN)
hainanica Yang & Yang, 1992 (BAU)
longicaudata Yang & Yang, 1992 (BAU)
quinlingensis Yang & Yang, 1989 (BAU)
sola Yang & Yang, 1992 (BAU)
telephora Yang & Yang, 1989 (BAU)
xizangana (Yang & Yang, 1988) **comb. n.** (BAU)
yulinica Yang & Yang, 1989 (BAU)
- SPECIES NEWLY EXCLUDED FROM *CHRYSOPELTA*
- Mallada anpingensis* (Esben-Petersen) **comb. n.**
Apertochrysa australis (New) **comb. n.**
Mallada krakatauensis (Tsukaguchi) **comb. n.**

- Mallada maquilingi* (Banks) **comb. n.**
Mallada meloui (Navás) **comb. n.**
Mallada satilota (Banks) **comb. n.**
Mallada suzukii (Okamoto) **comb. n.**
Apertochrysa triactinata (New) **comb. n.**

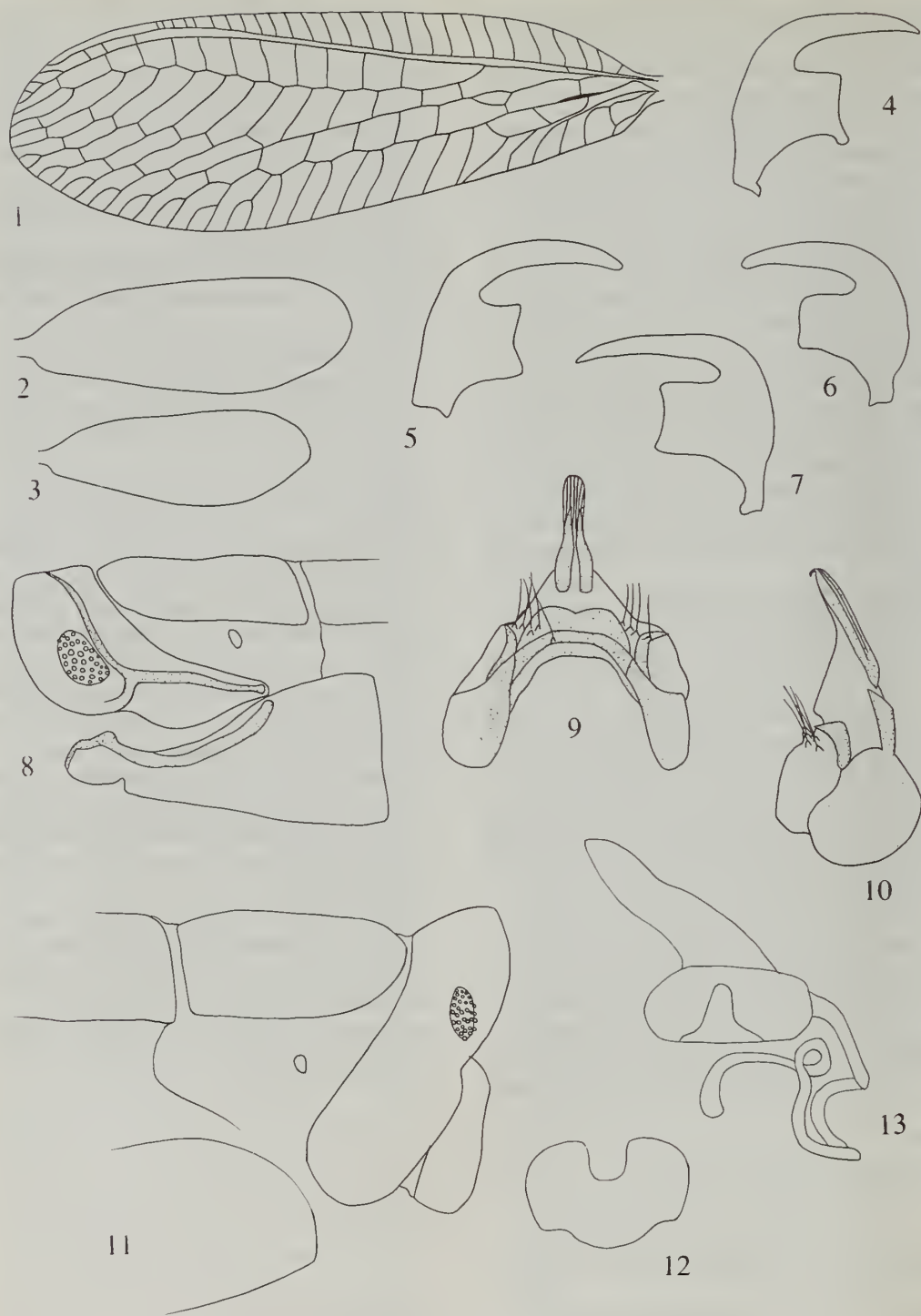
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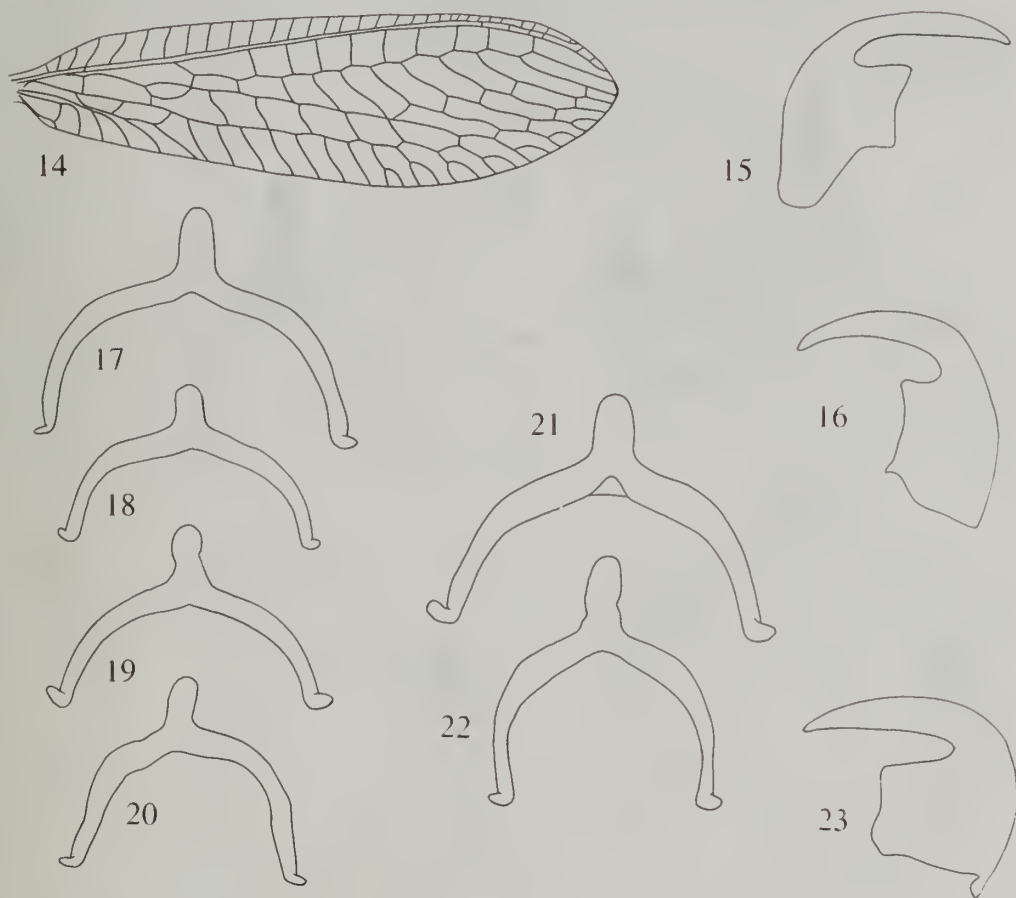
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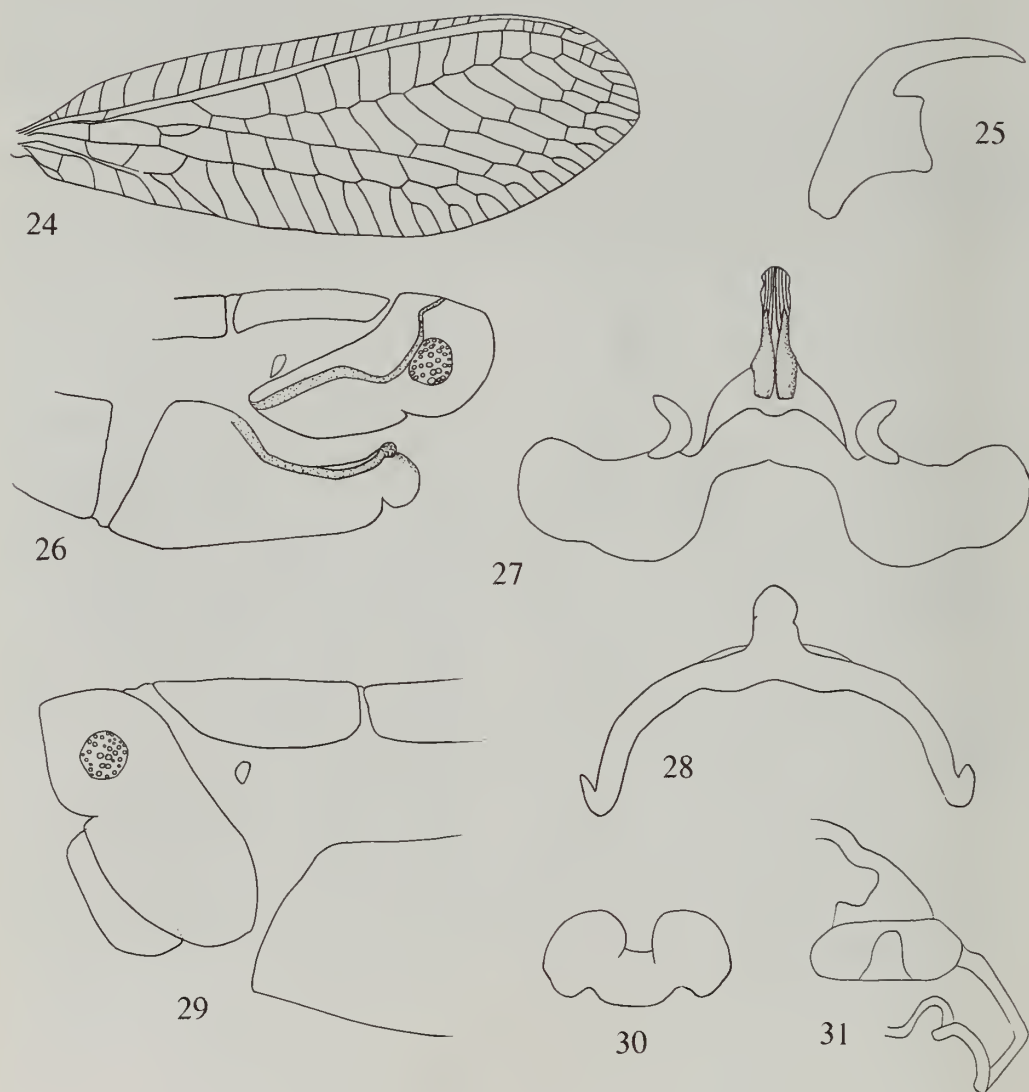
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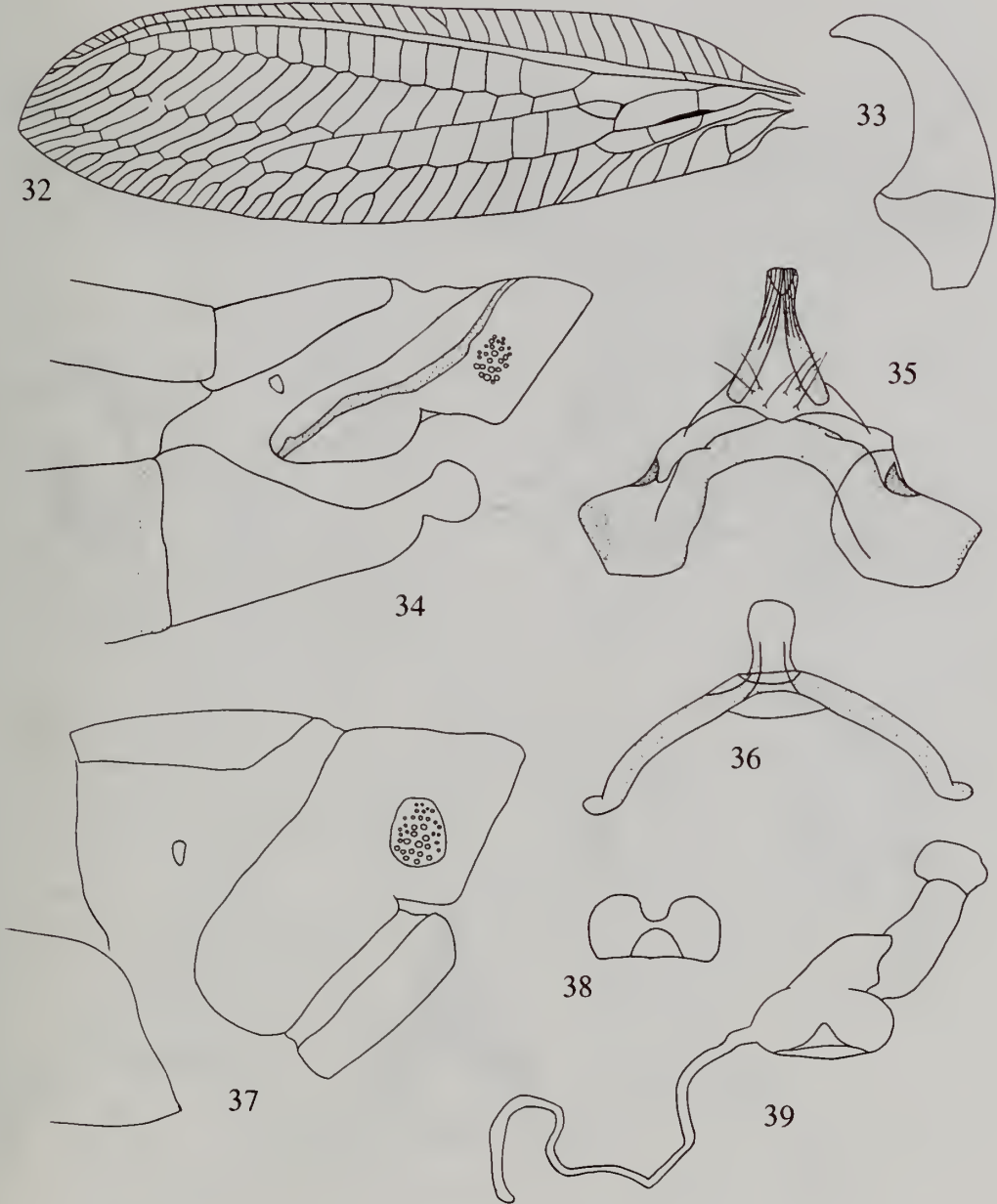
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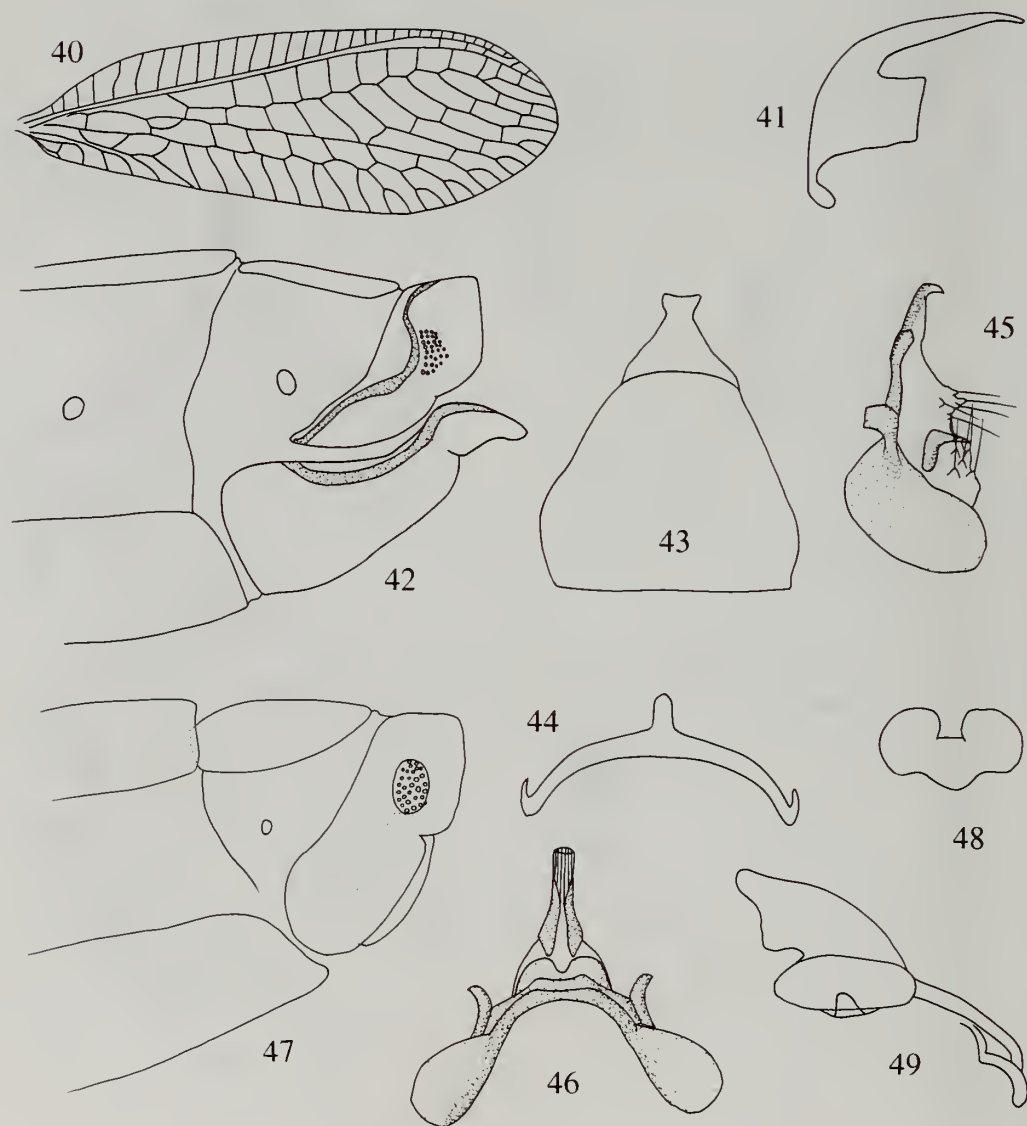
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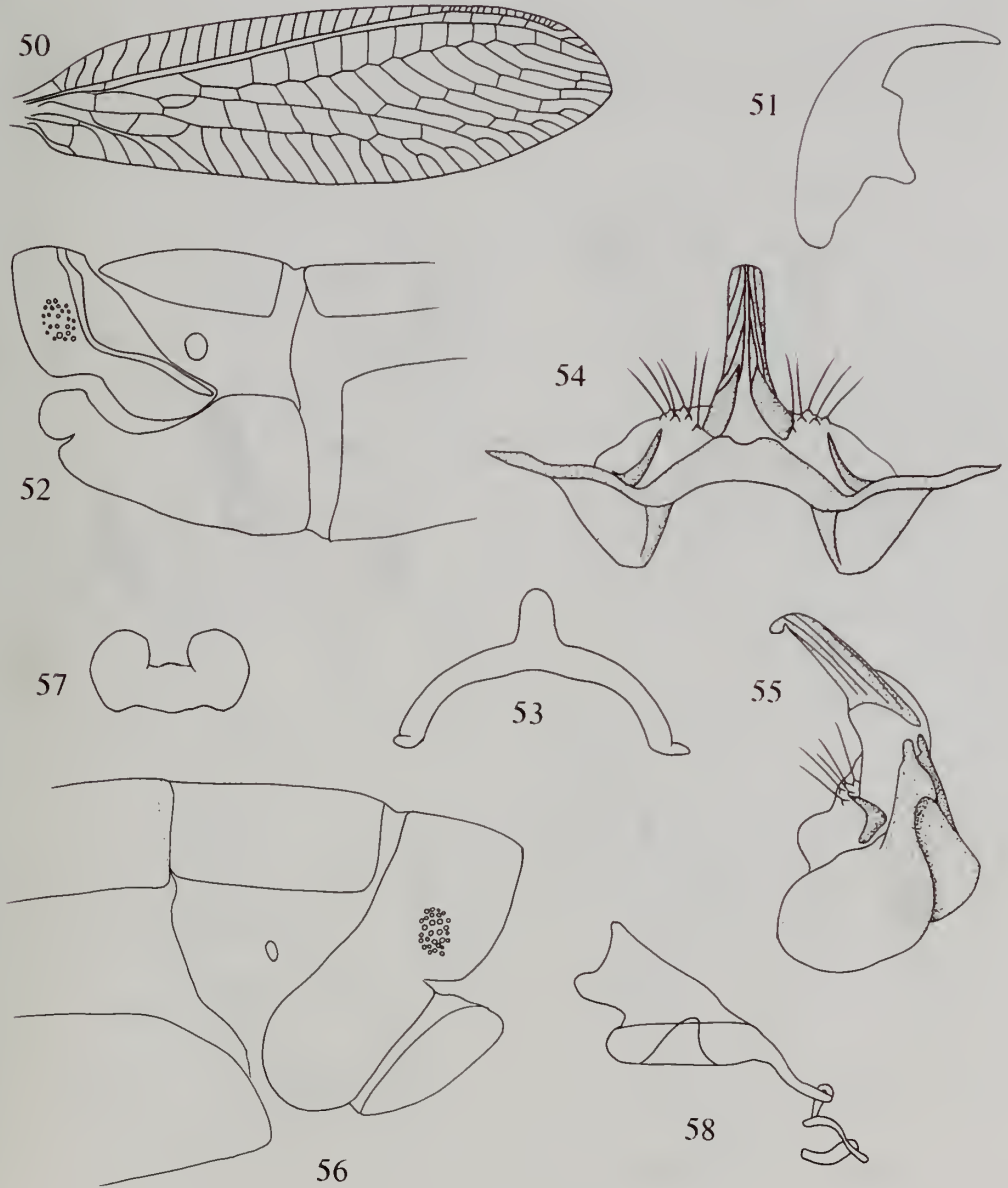
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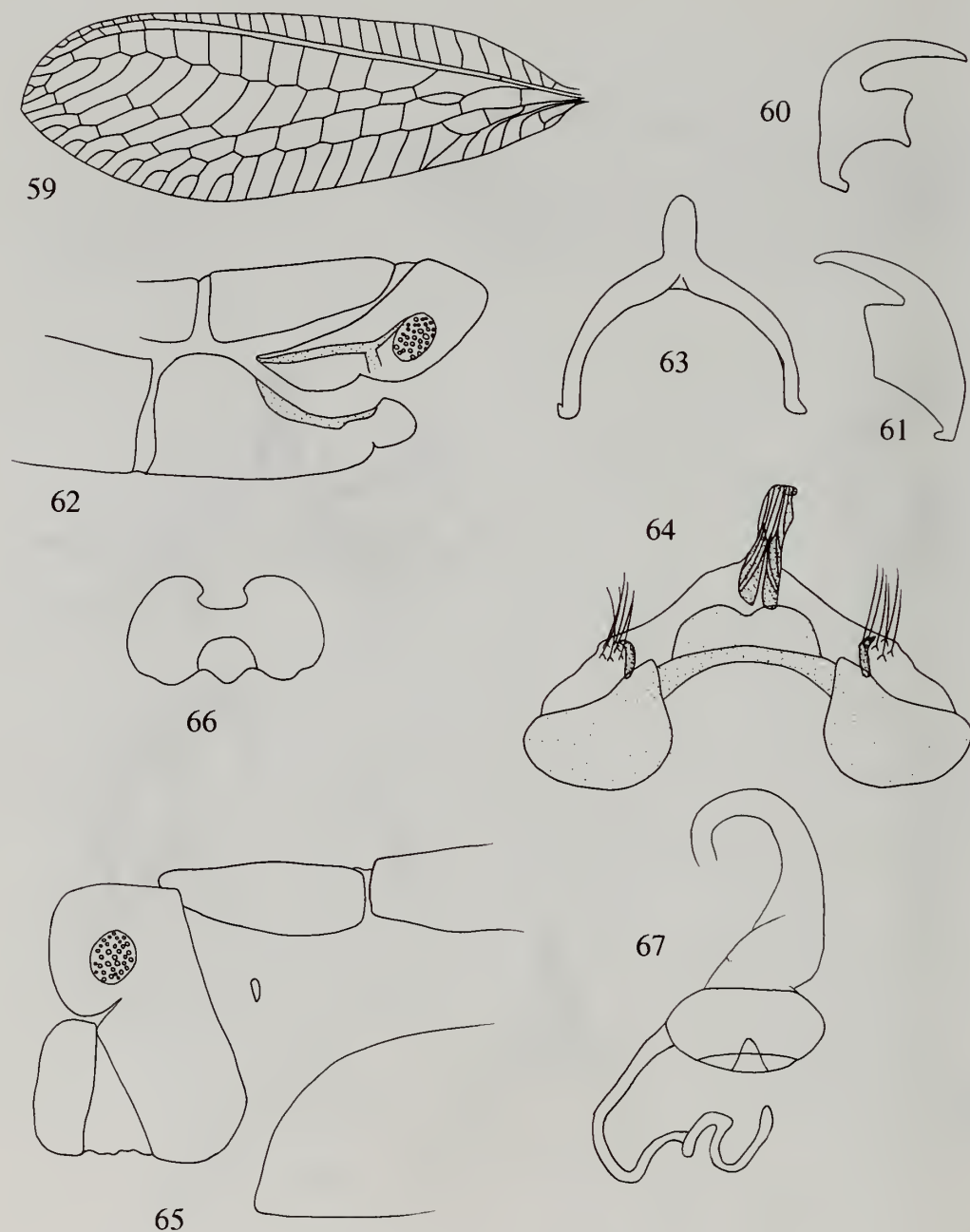
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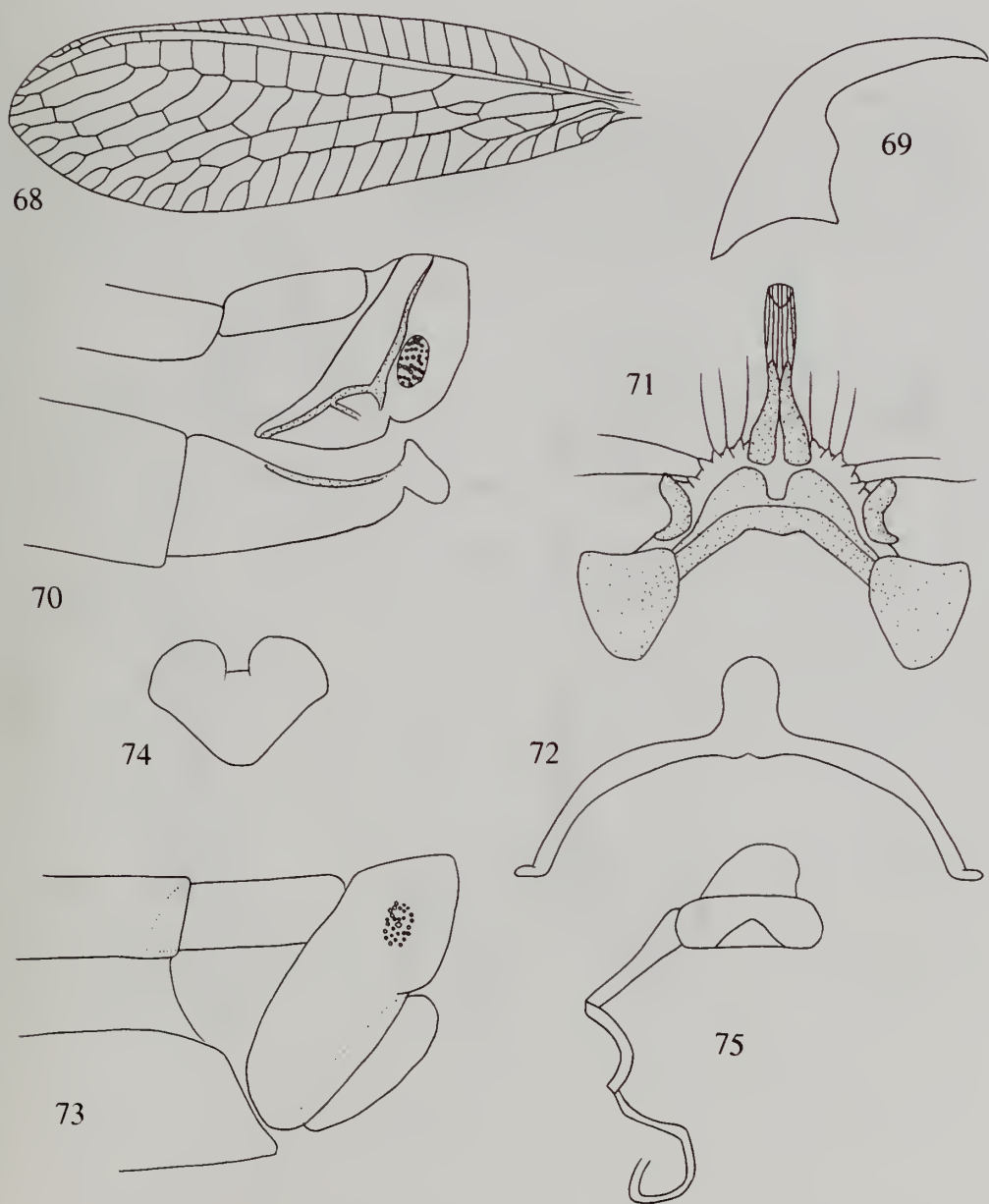
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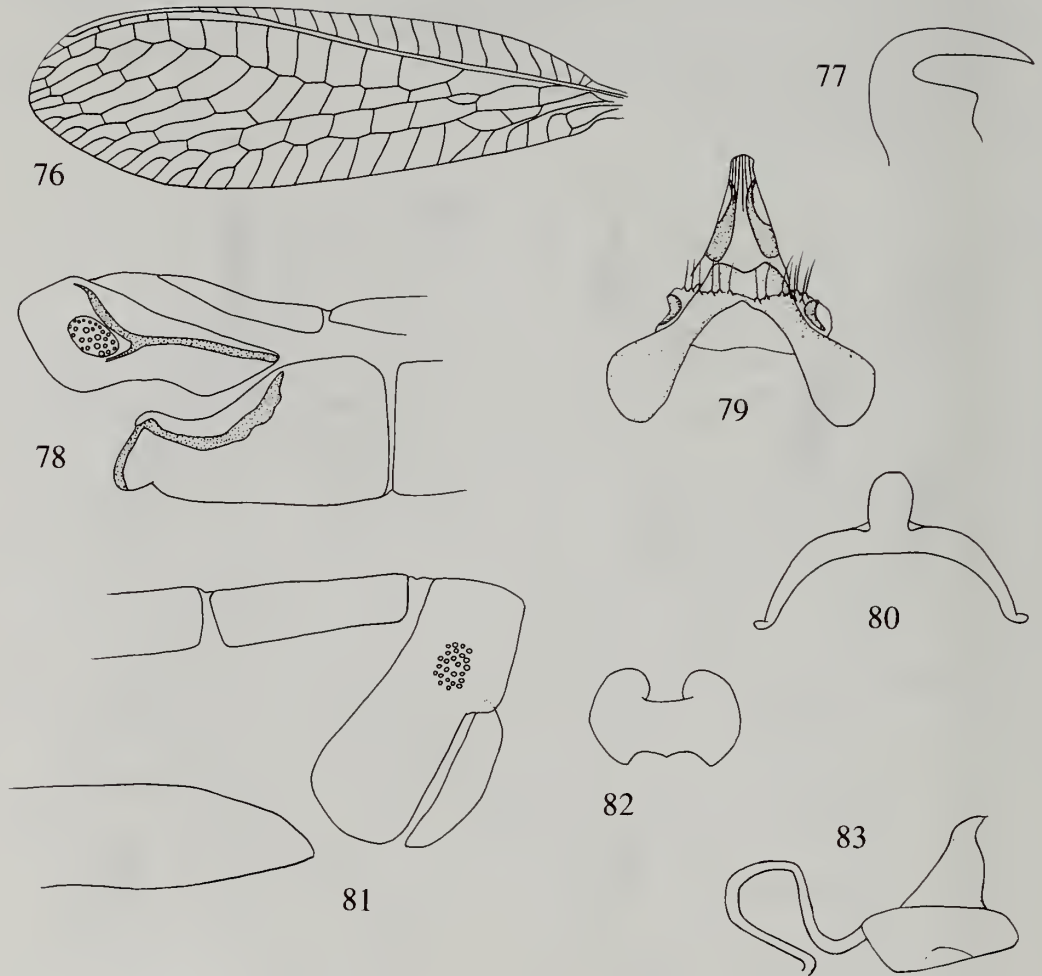
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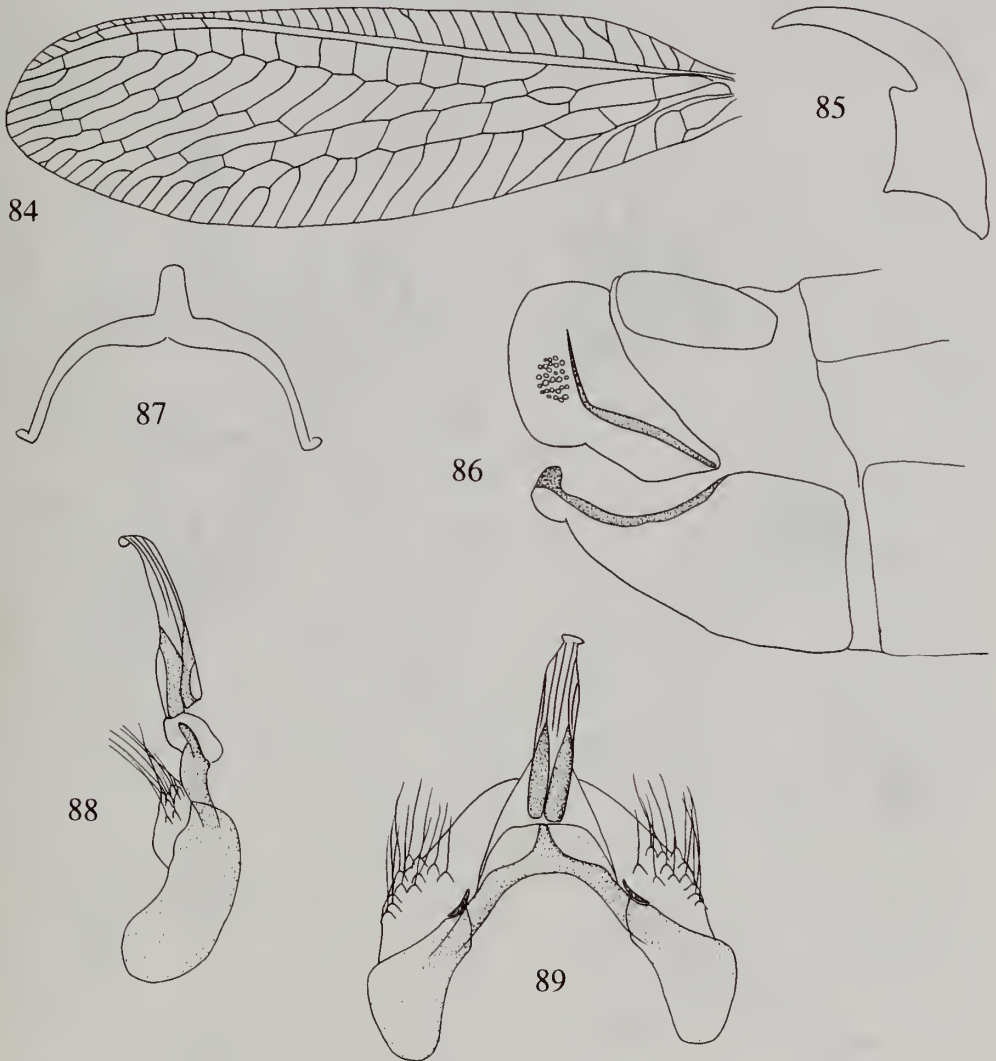
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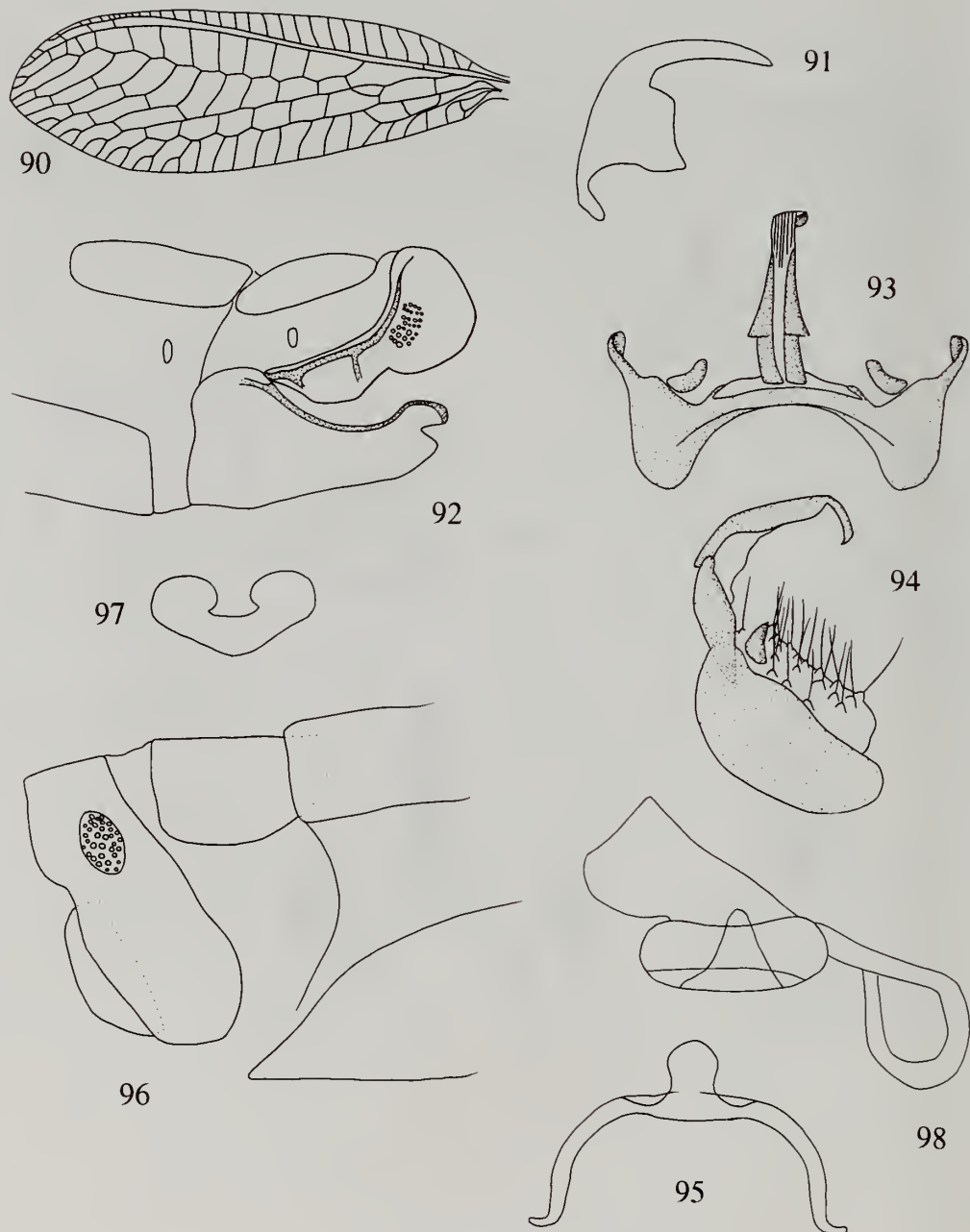
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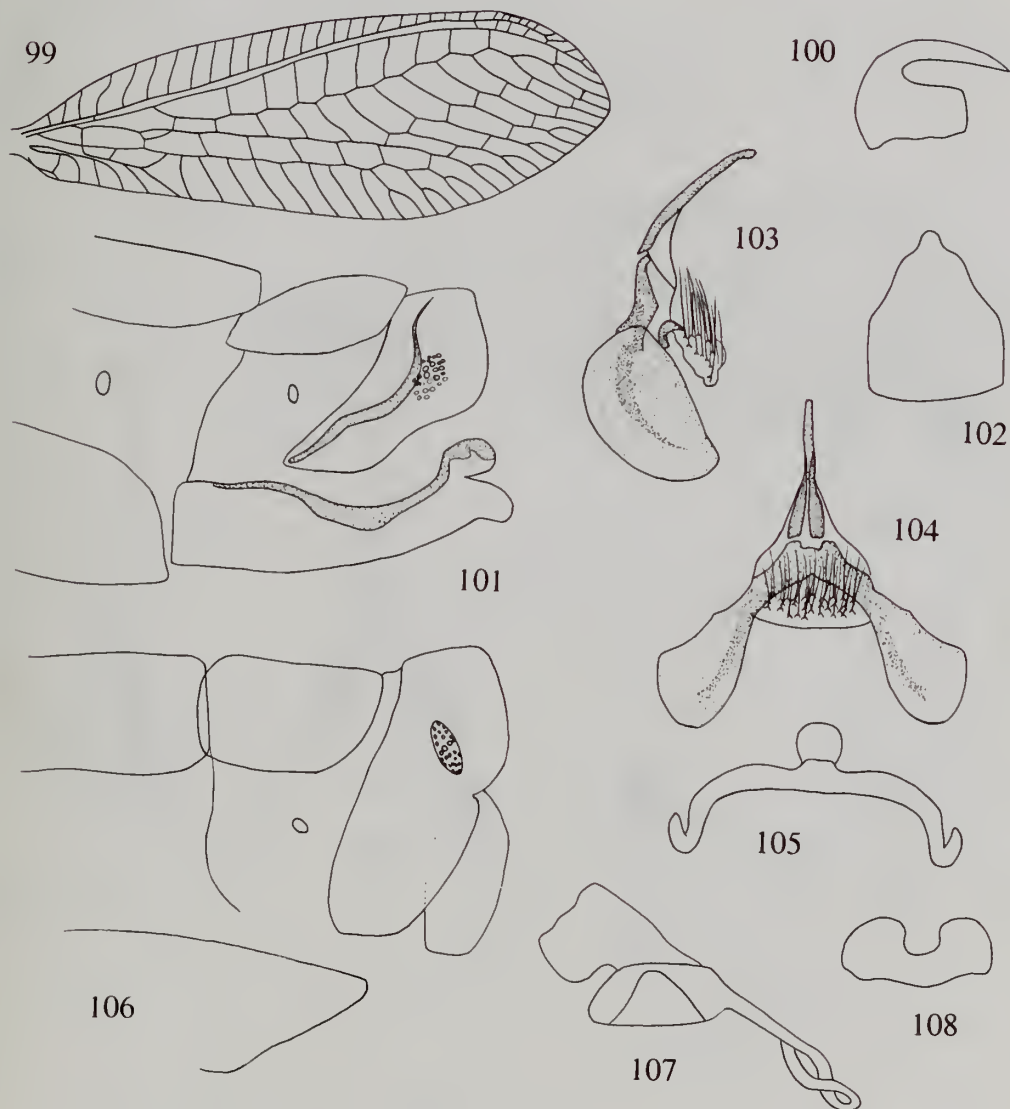
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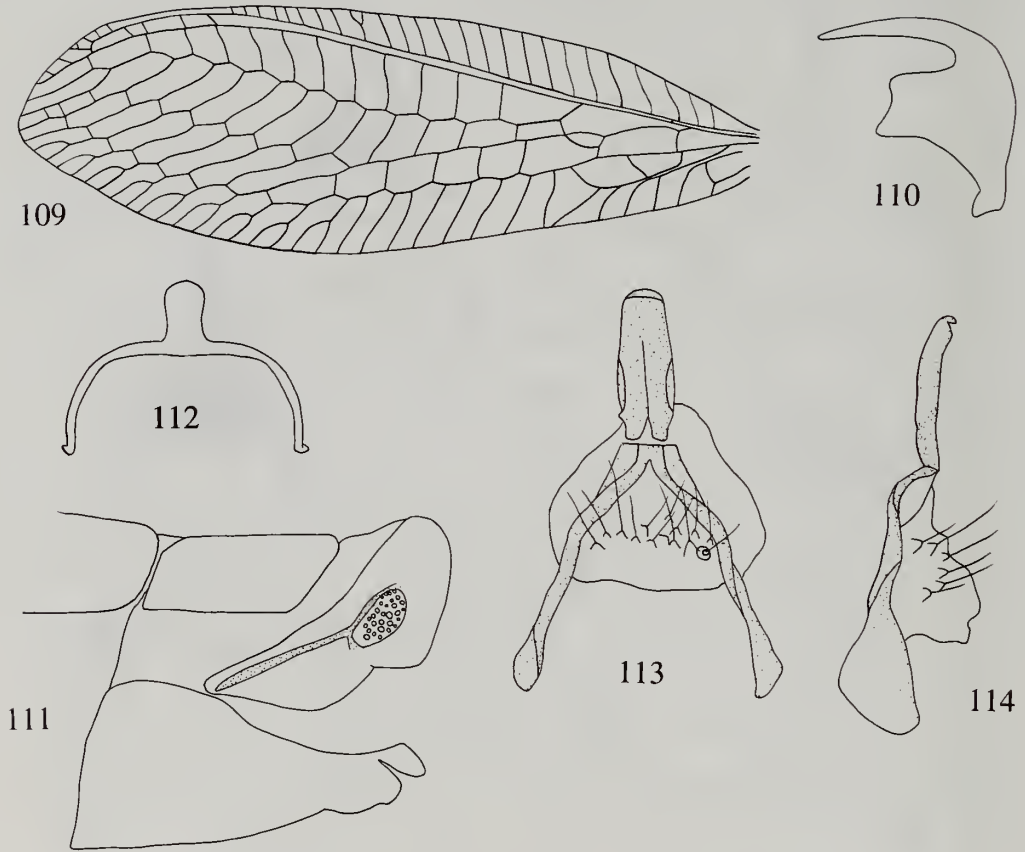
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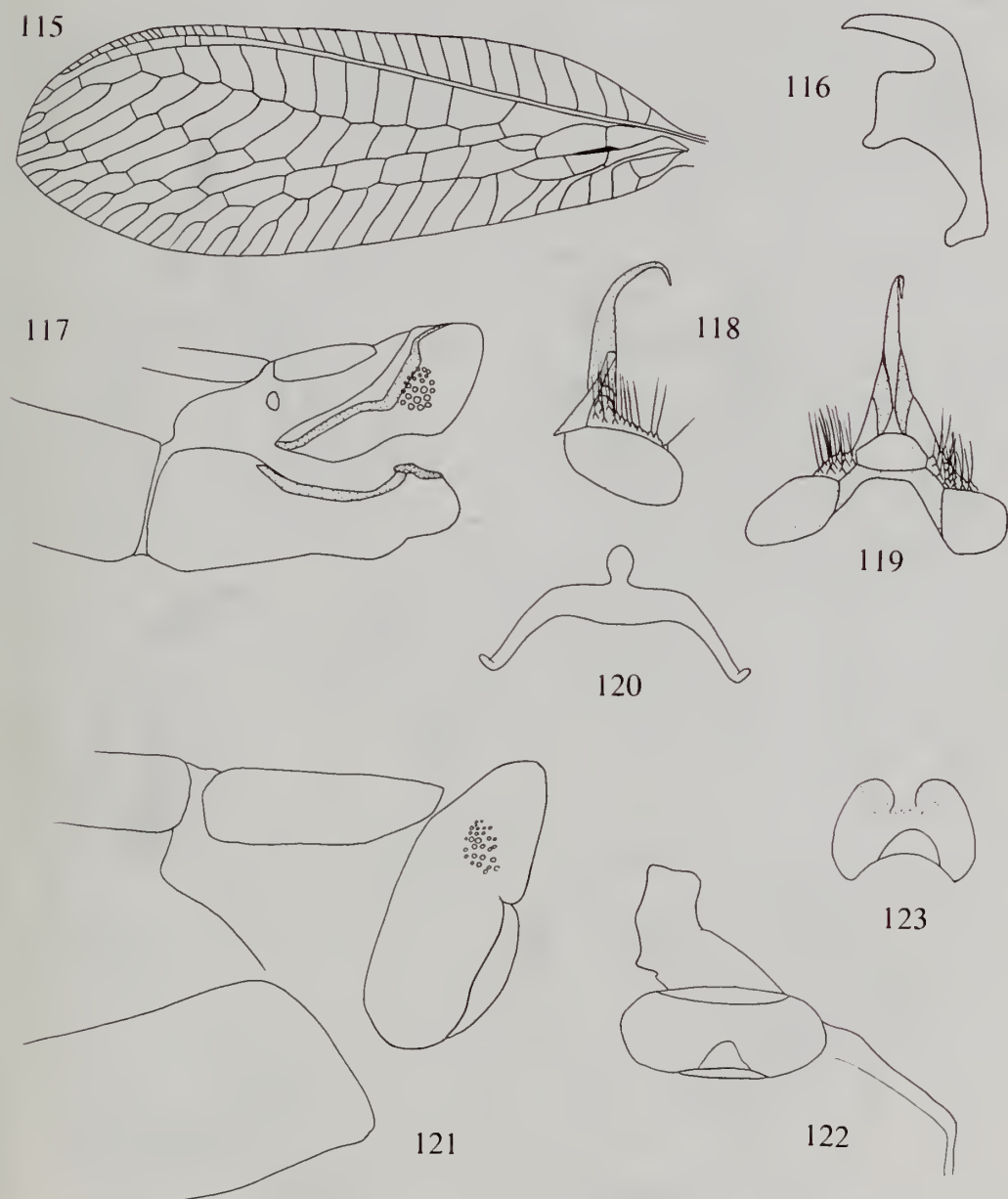
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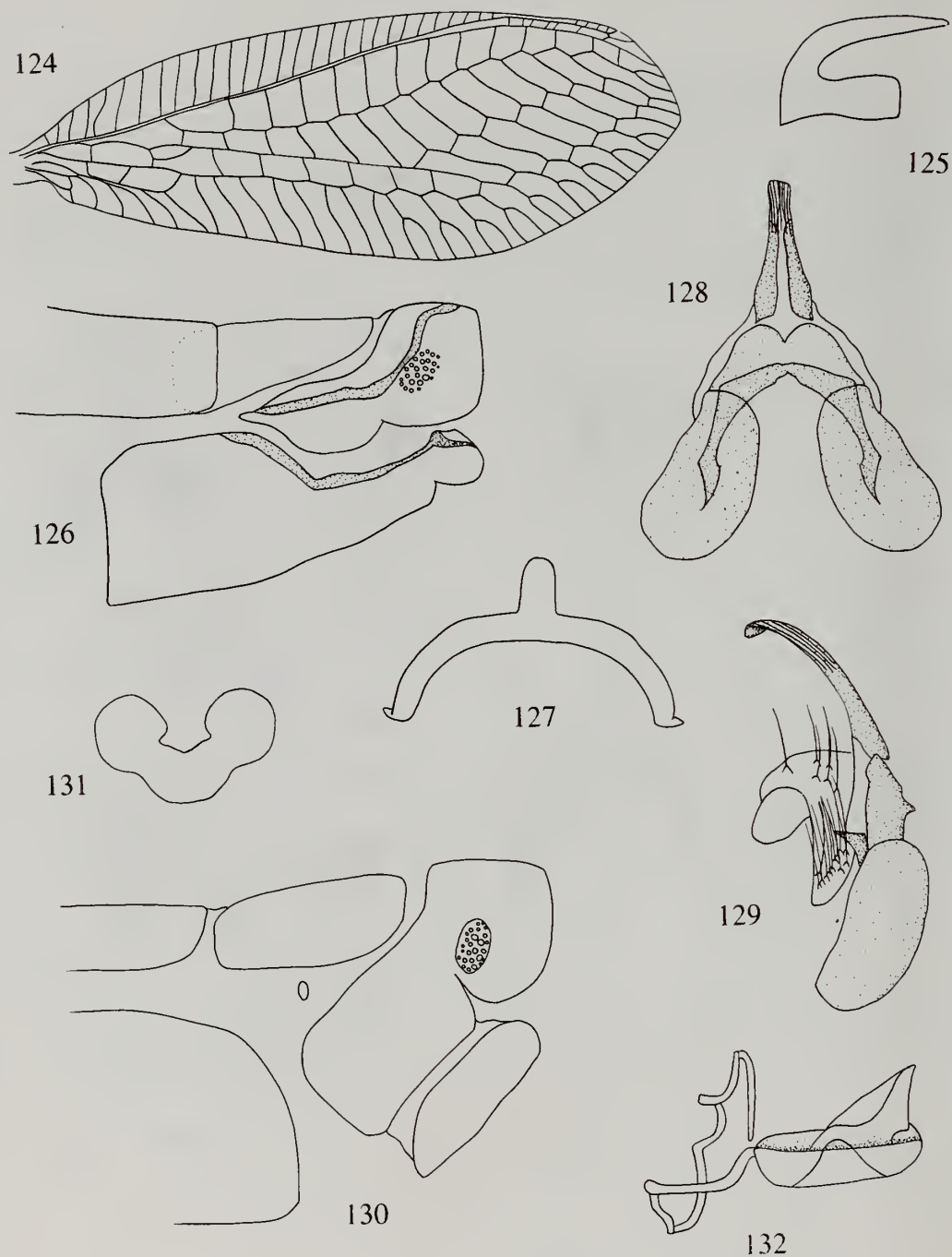
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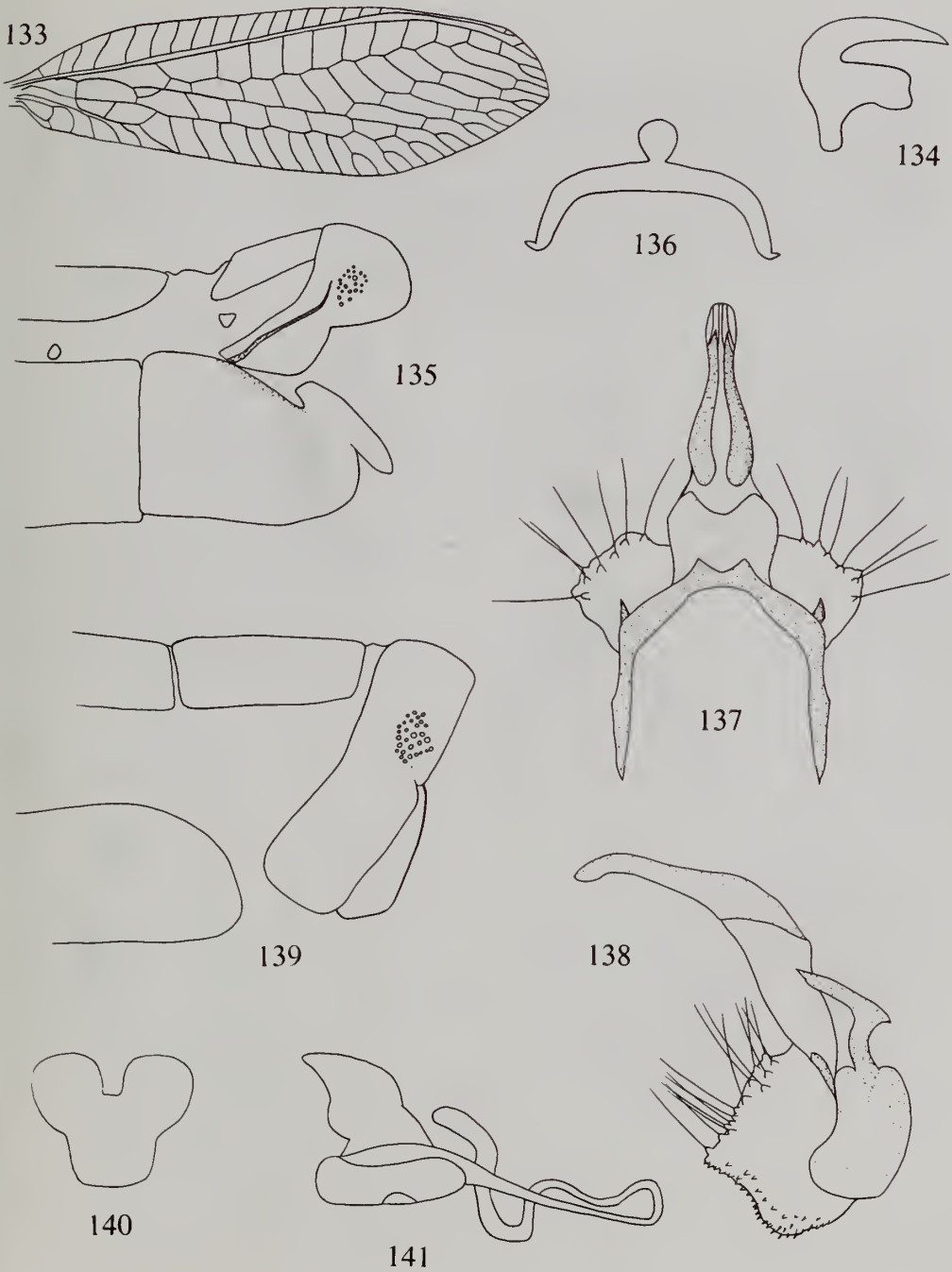
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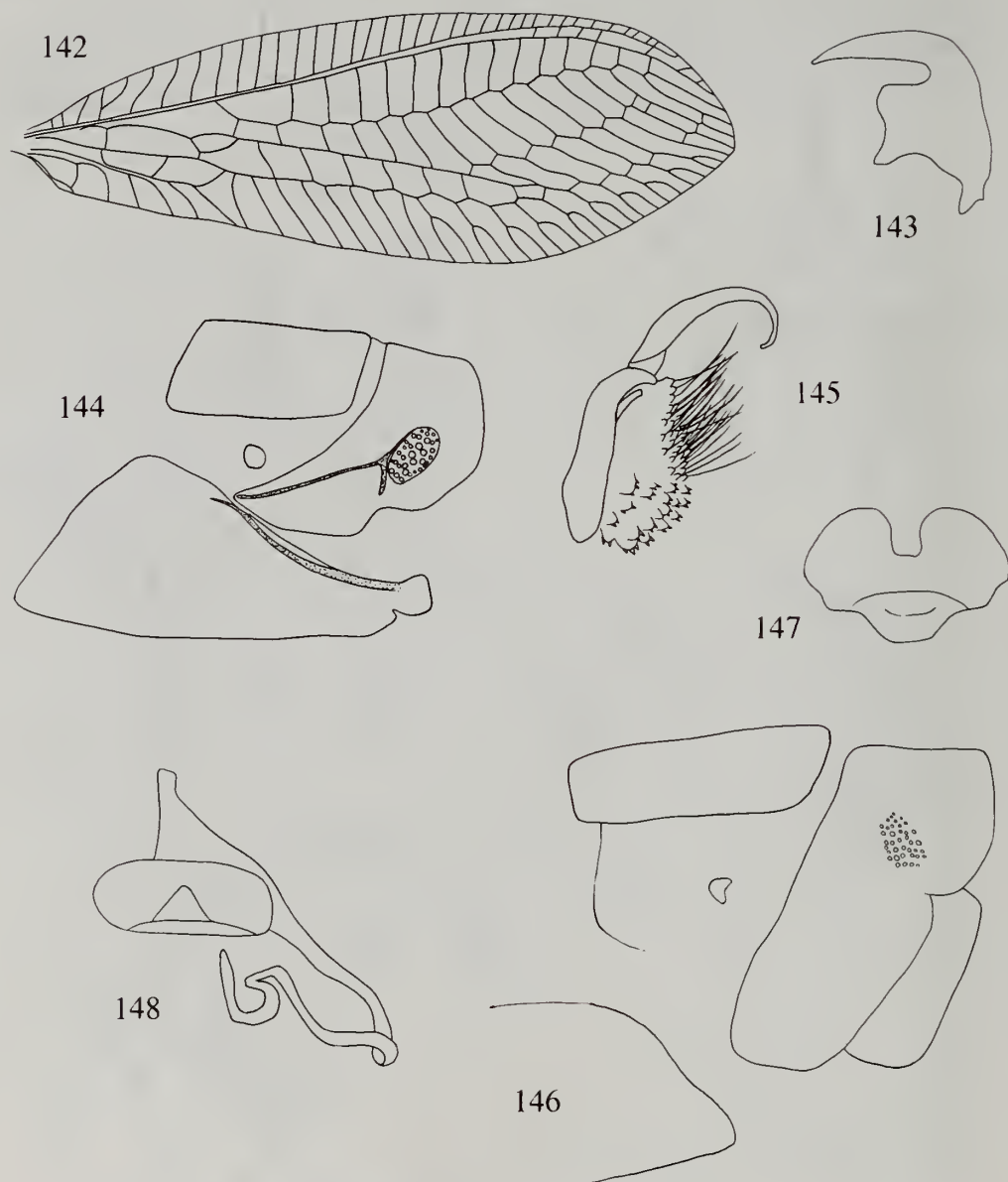
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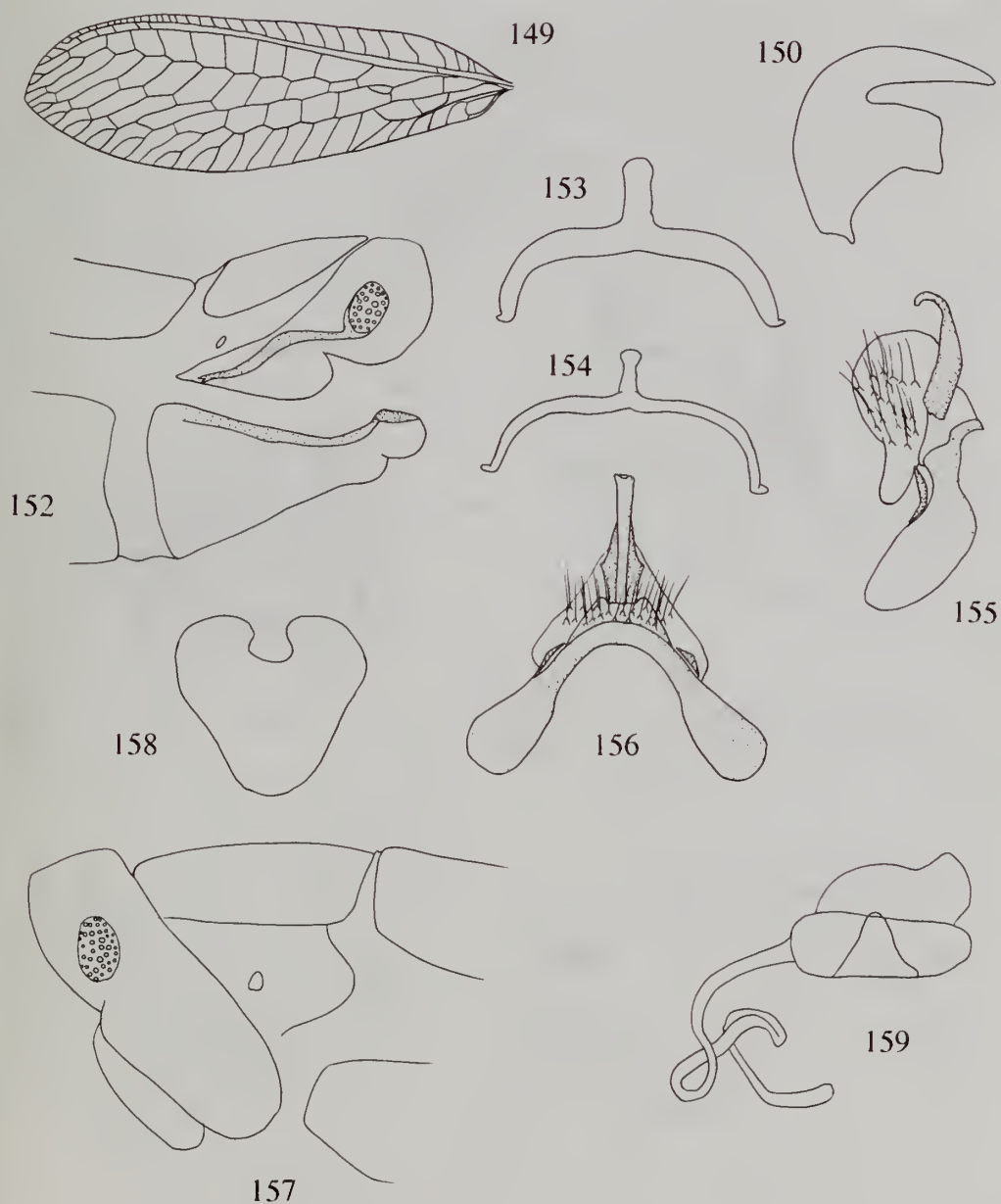
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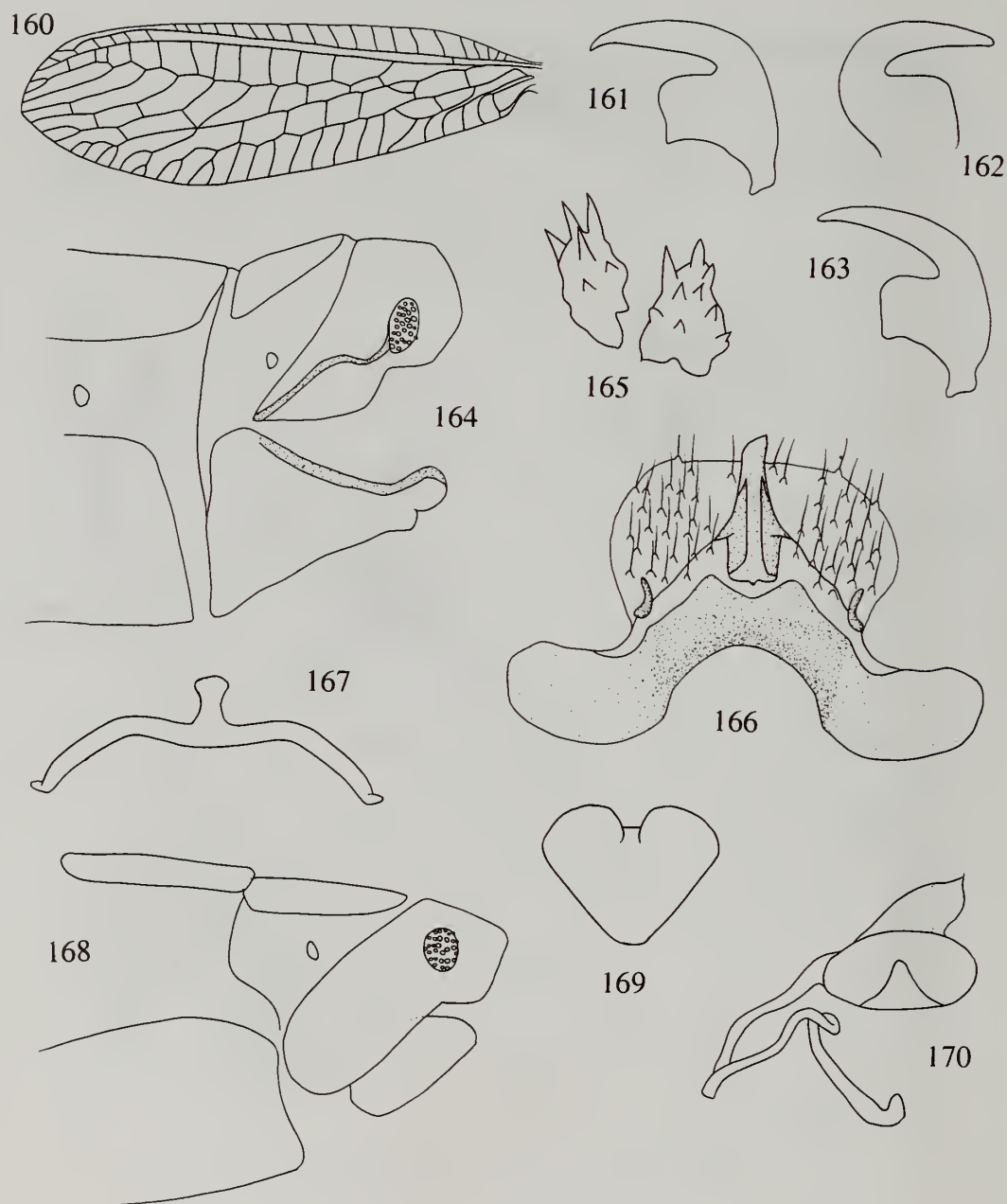
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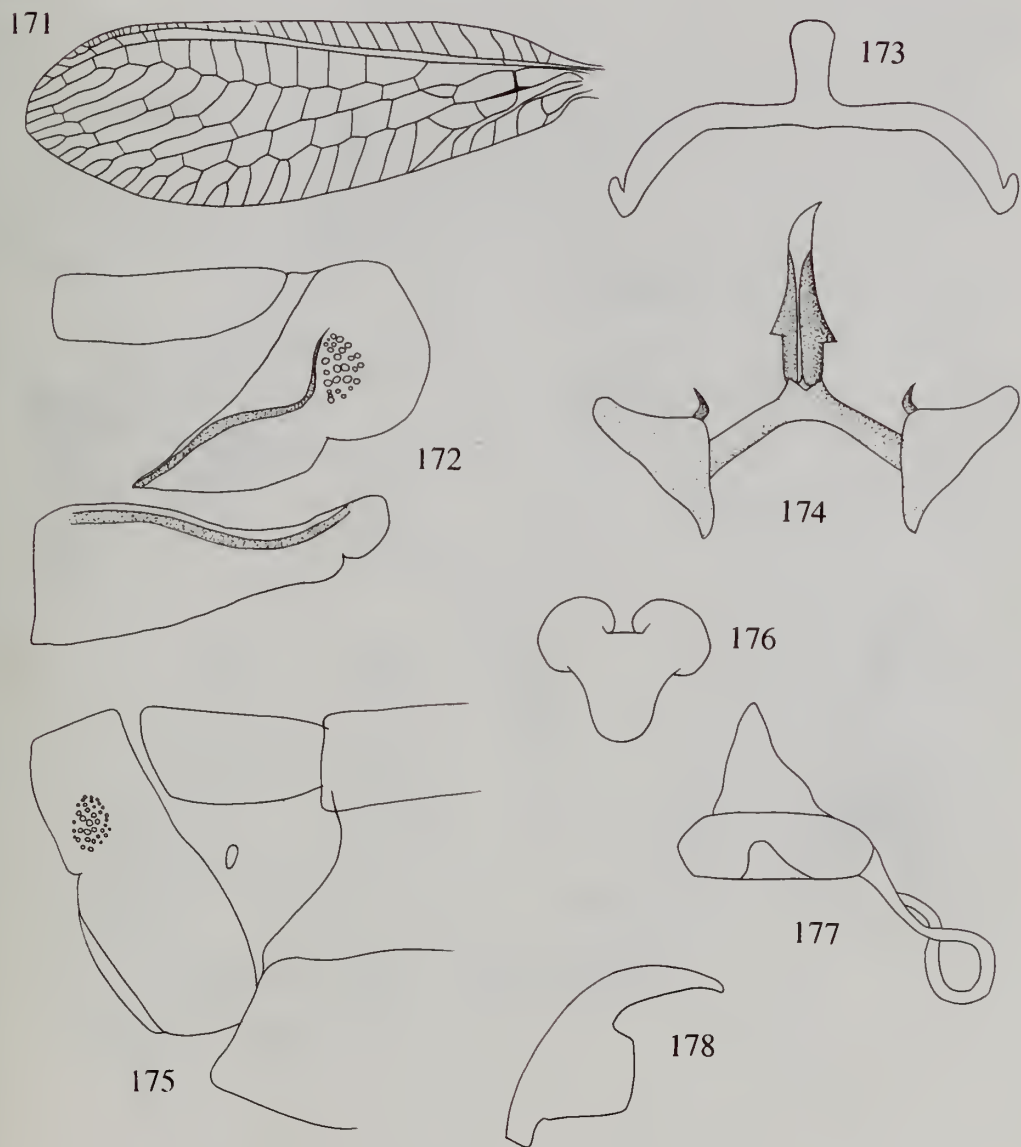
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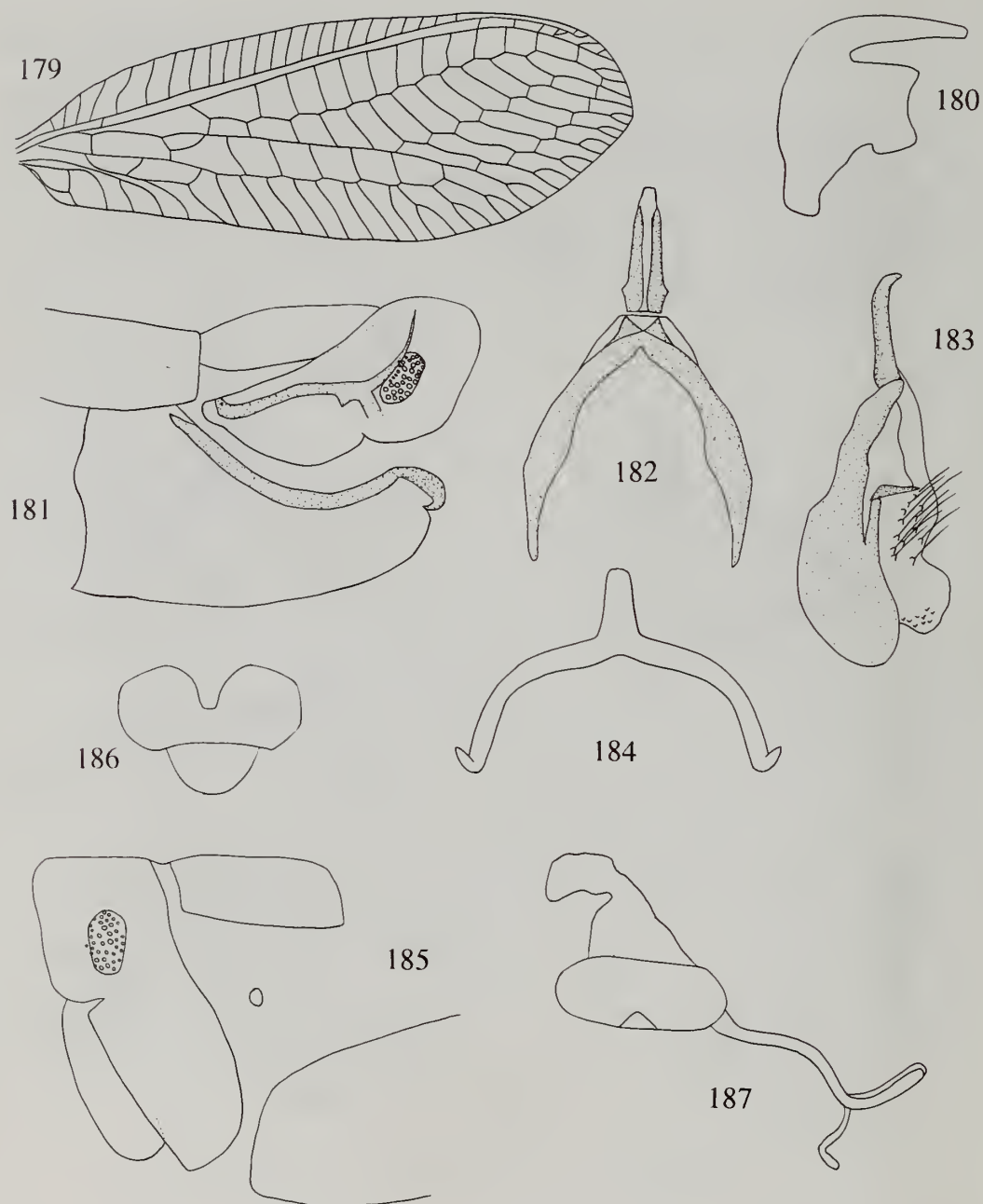
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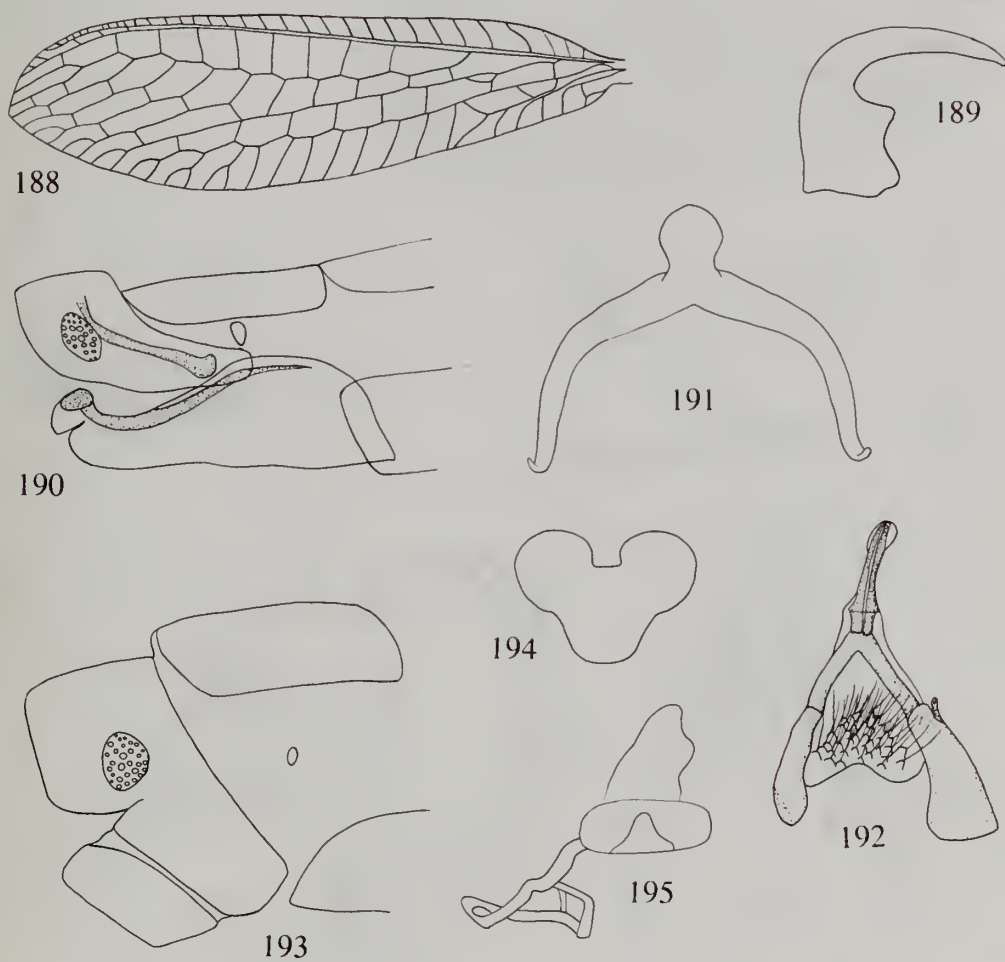
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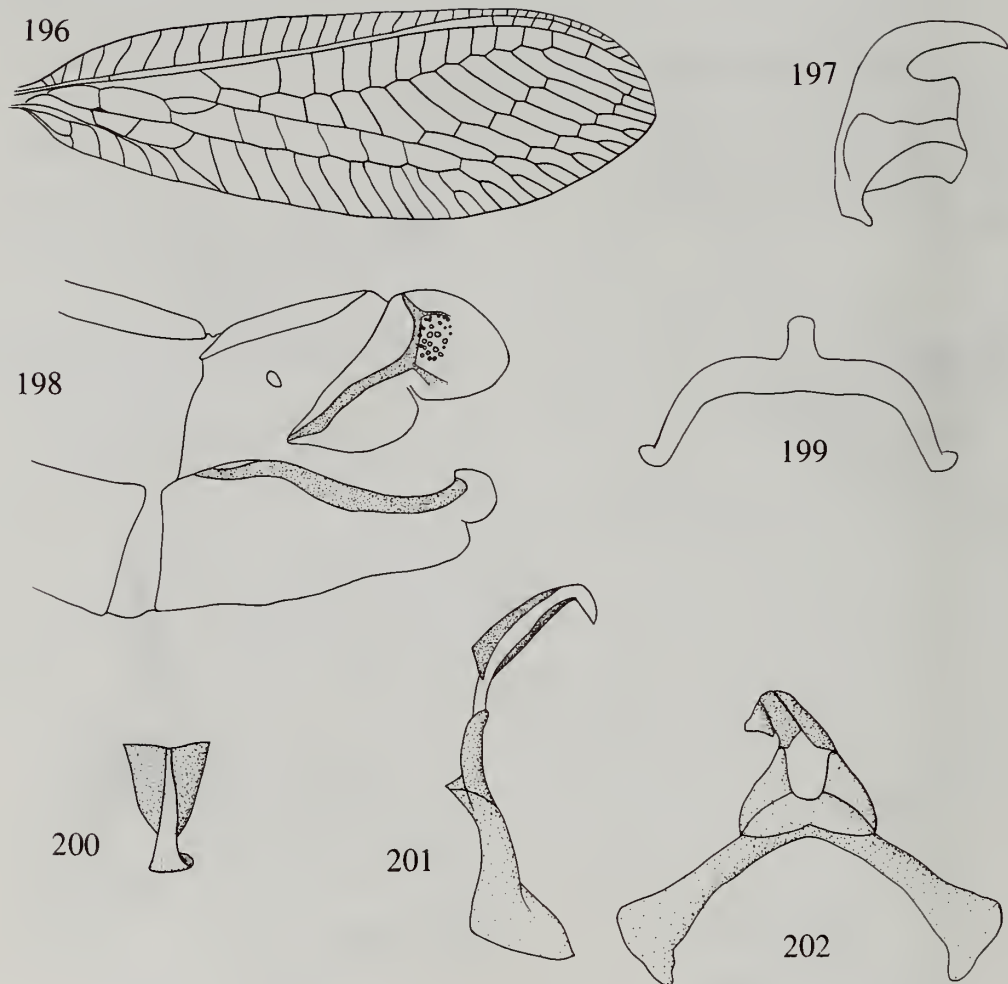
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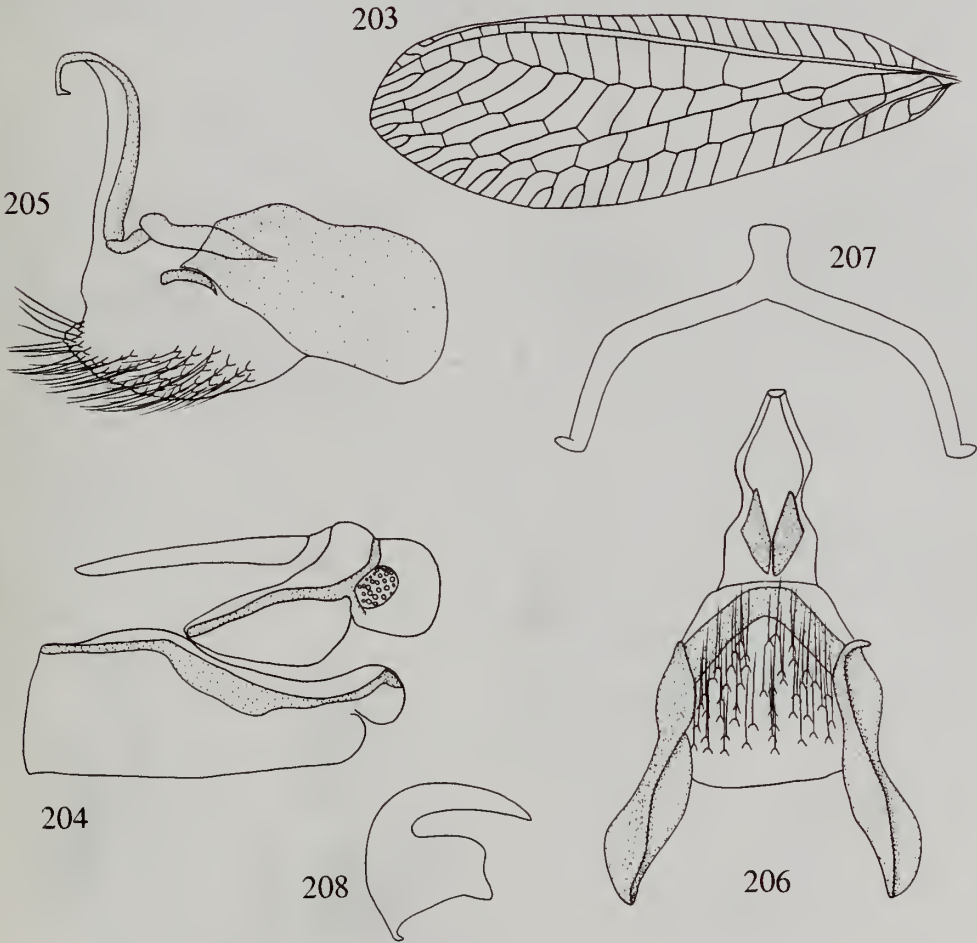
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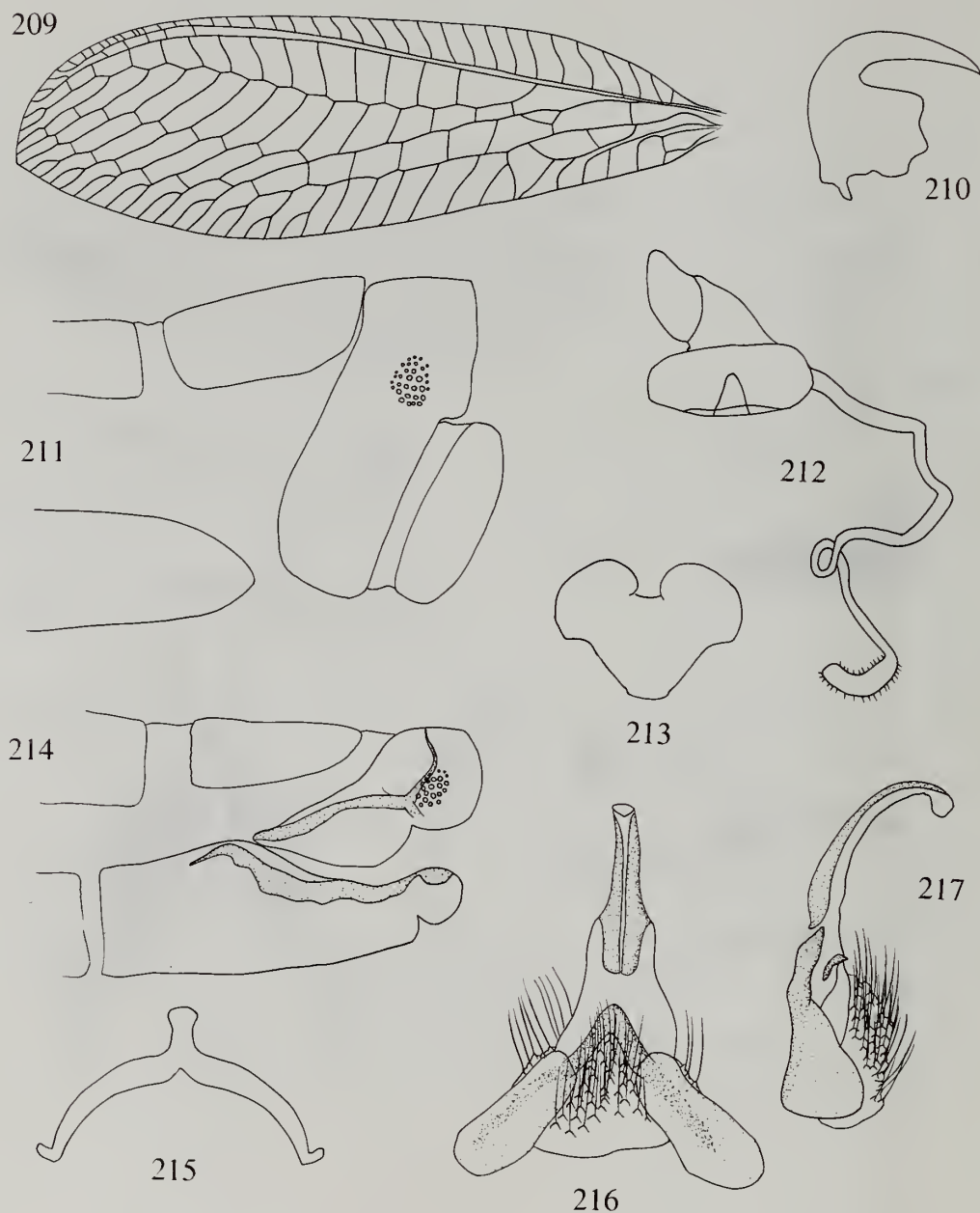
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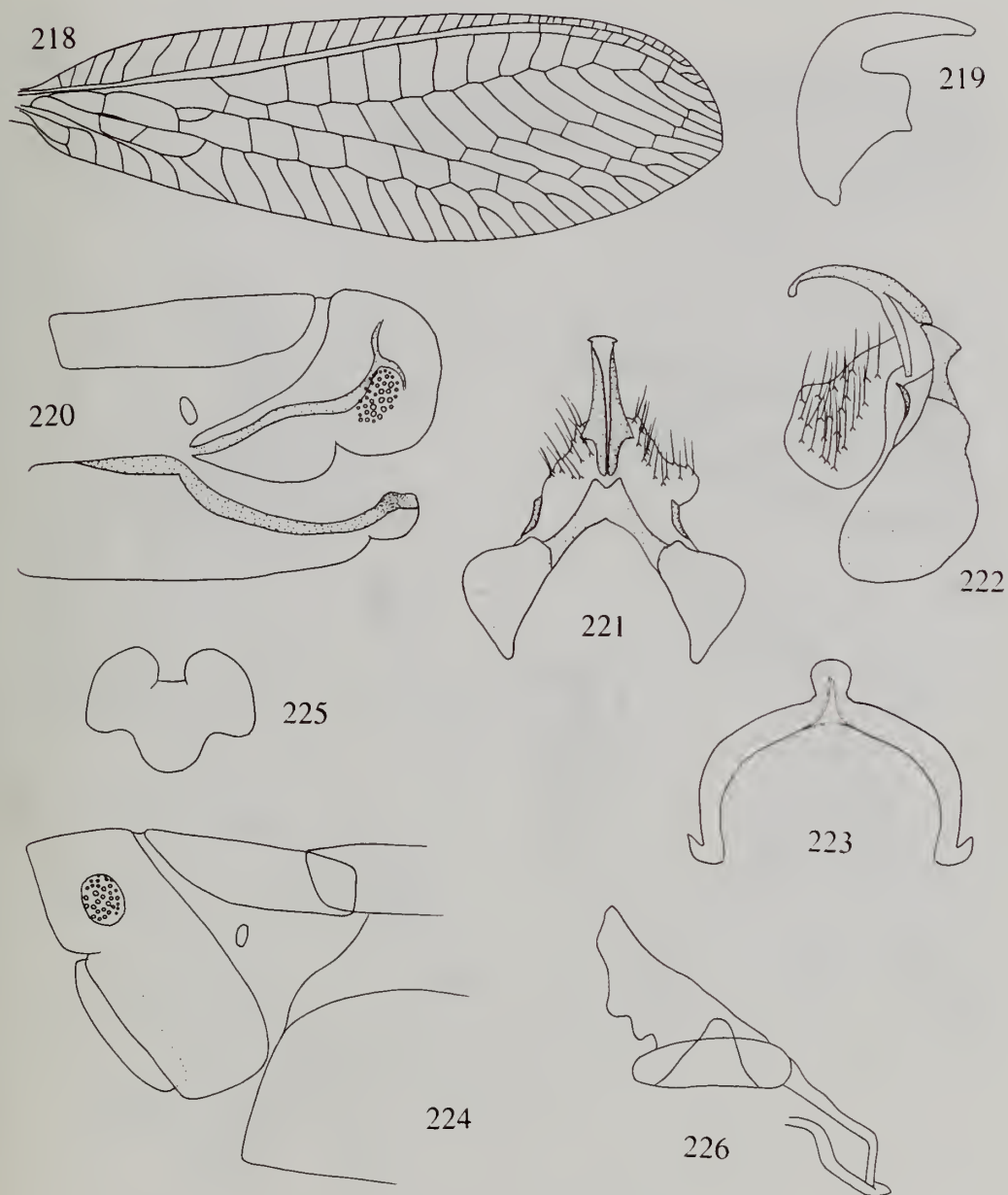
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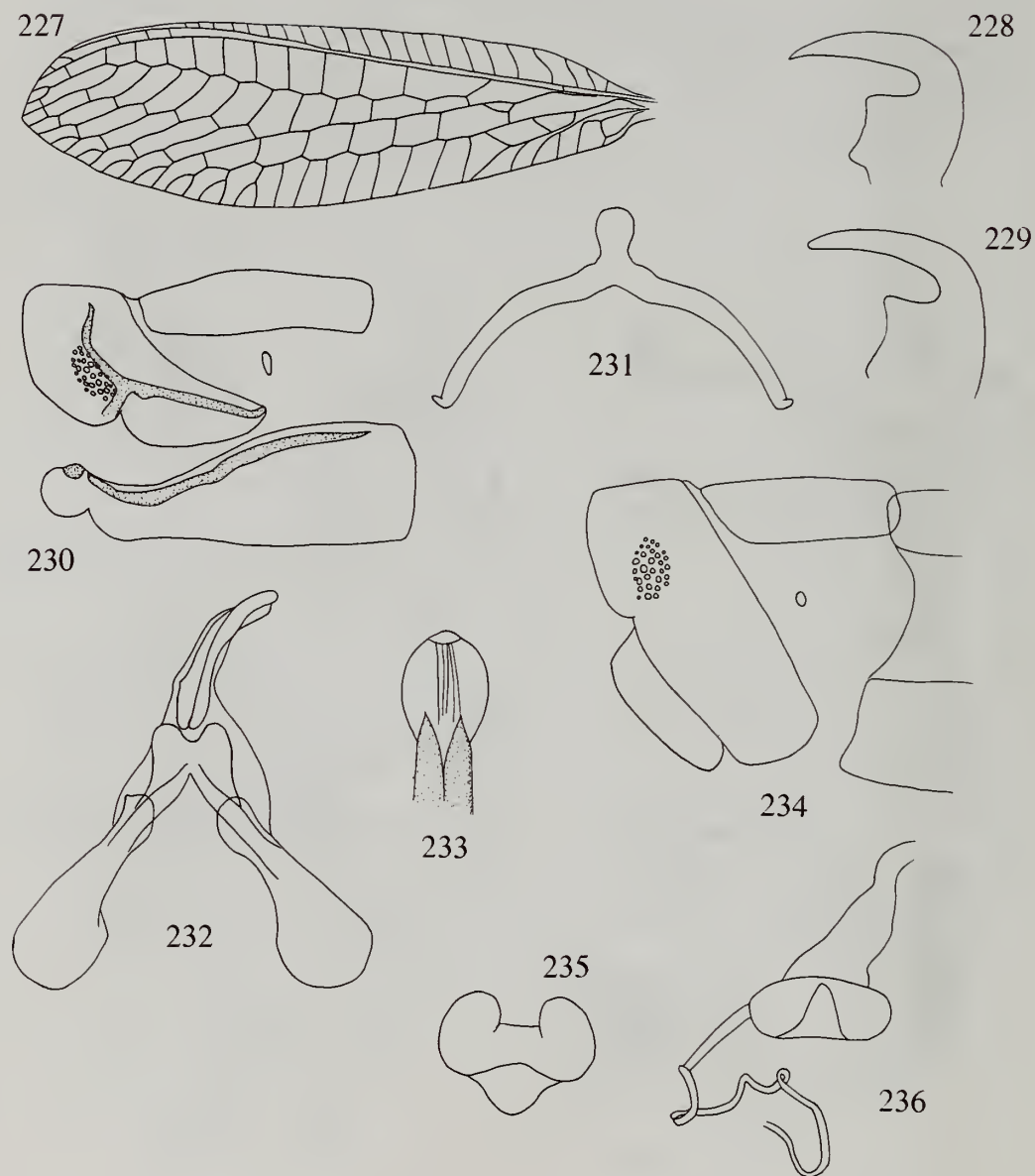
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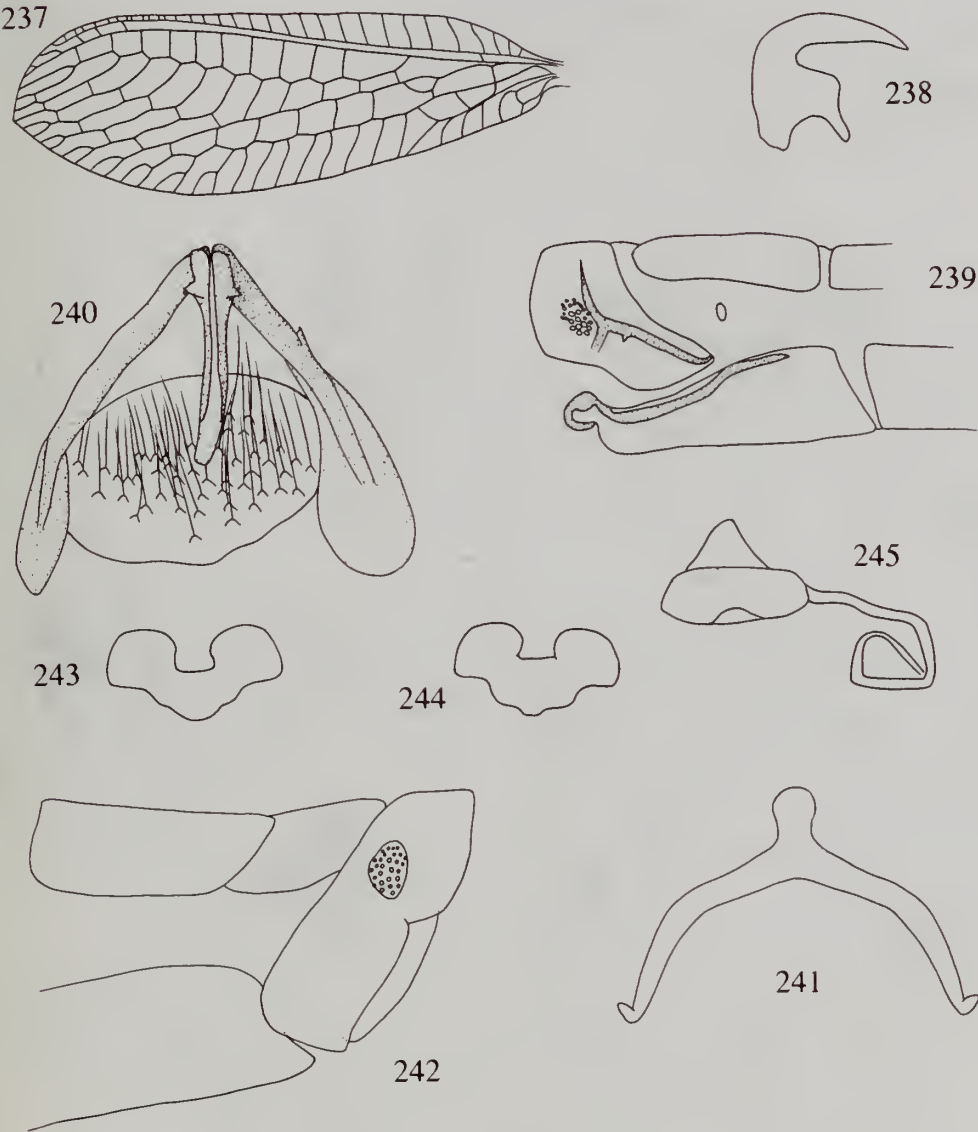
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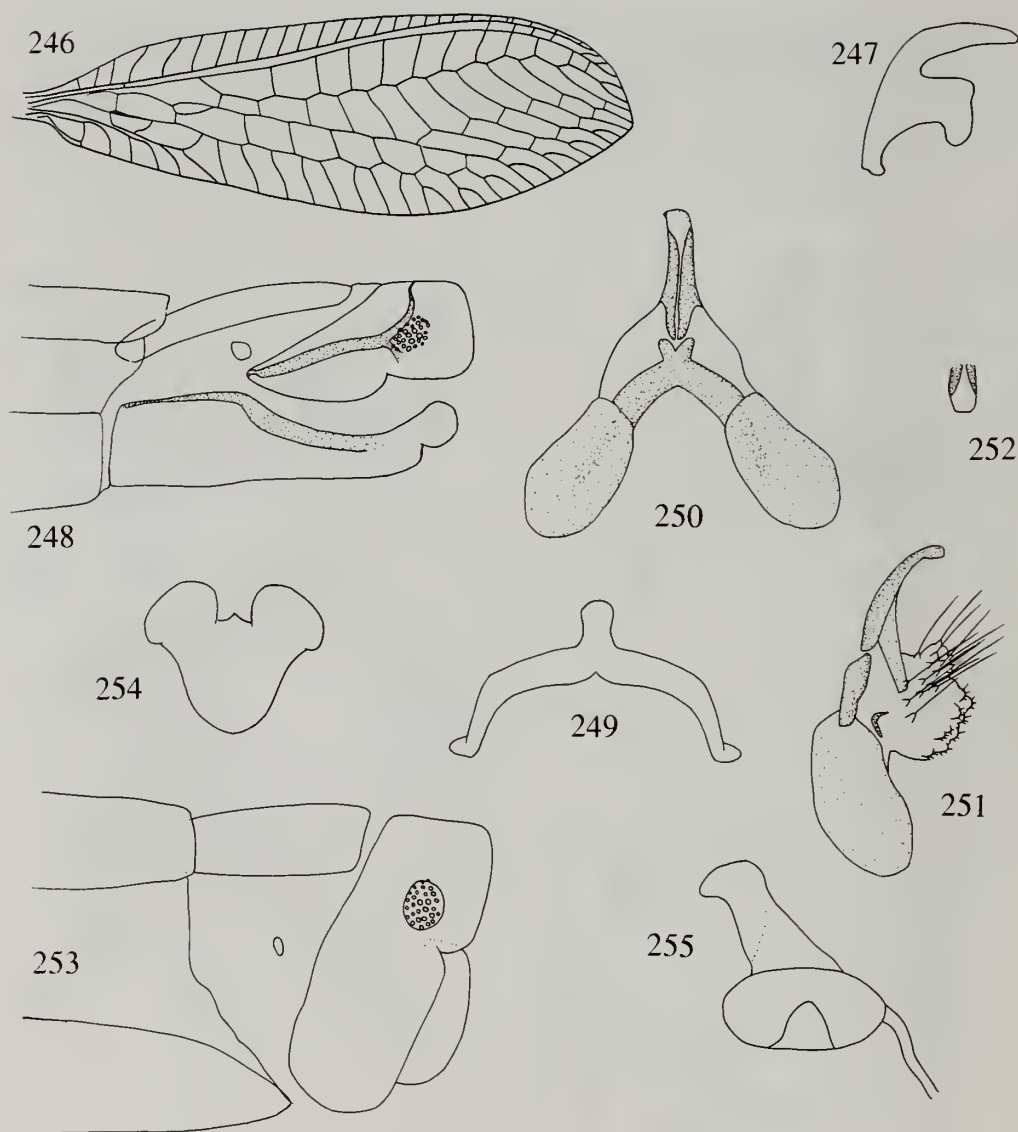
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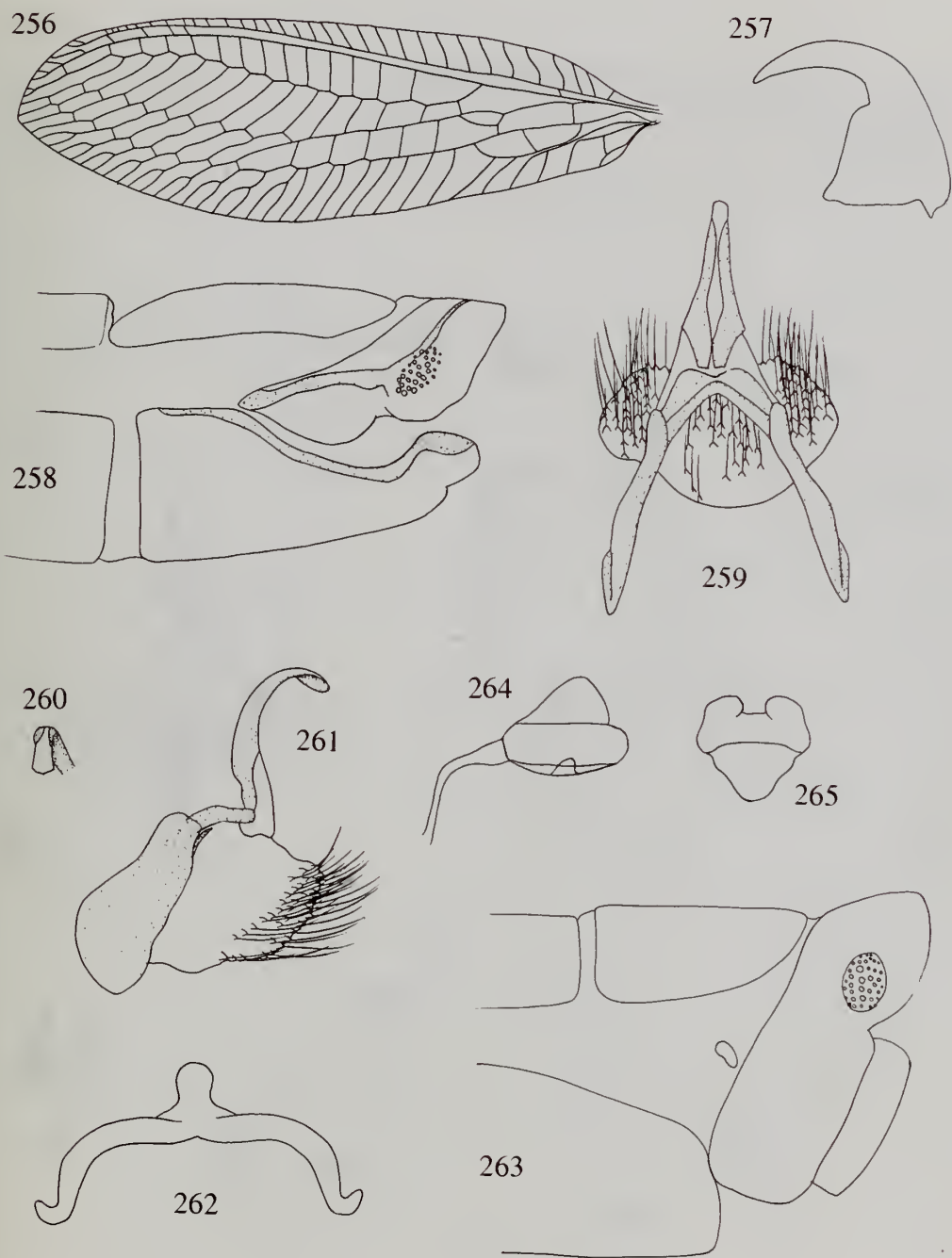
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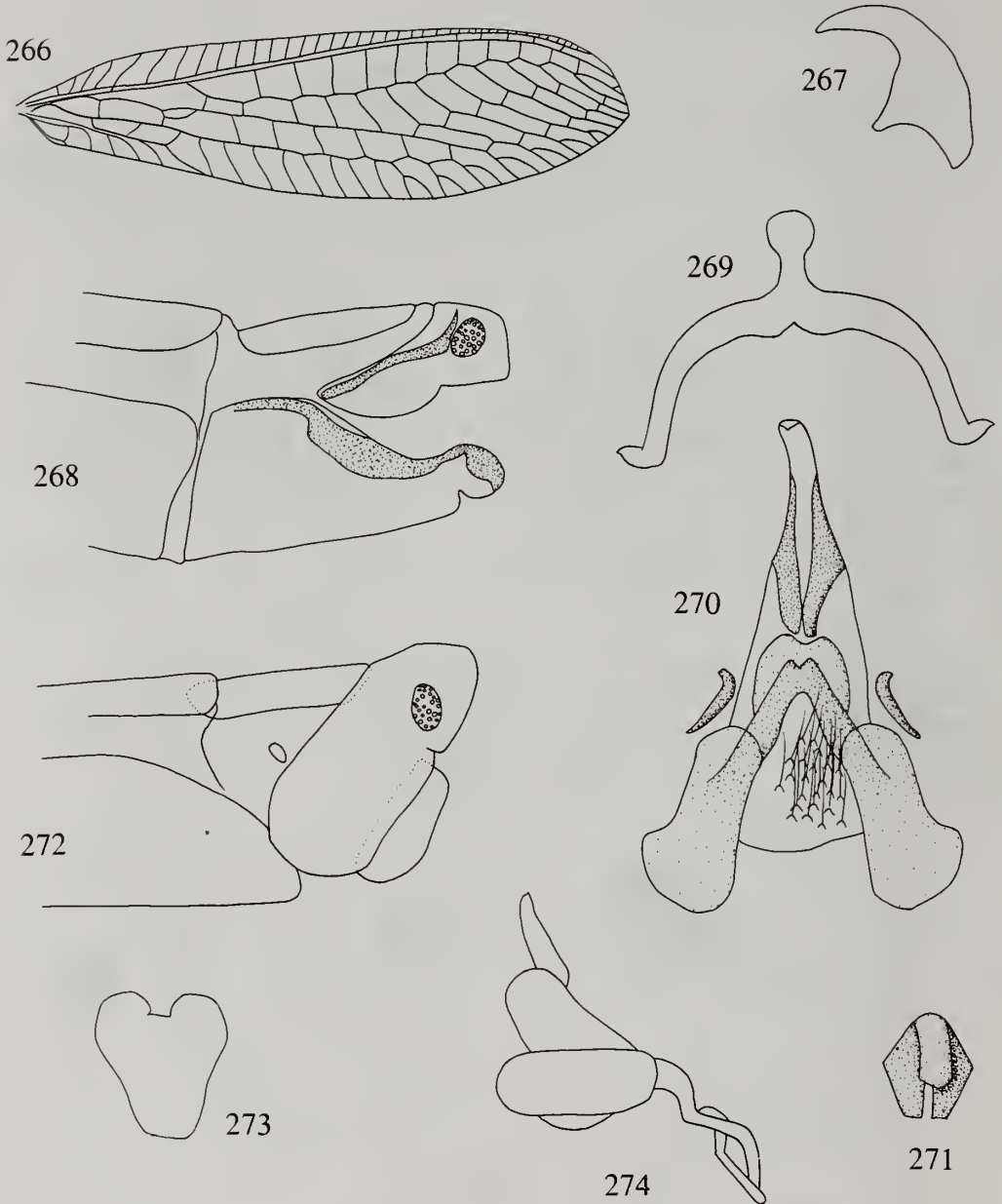
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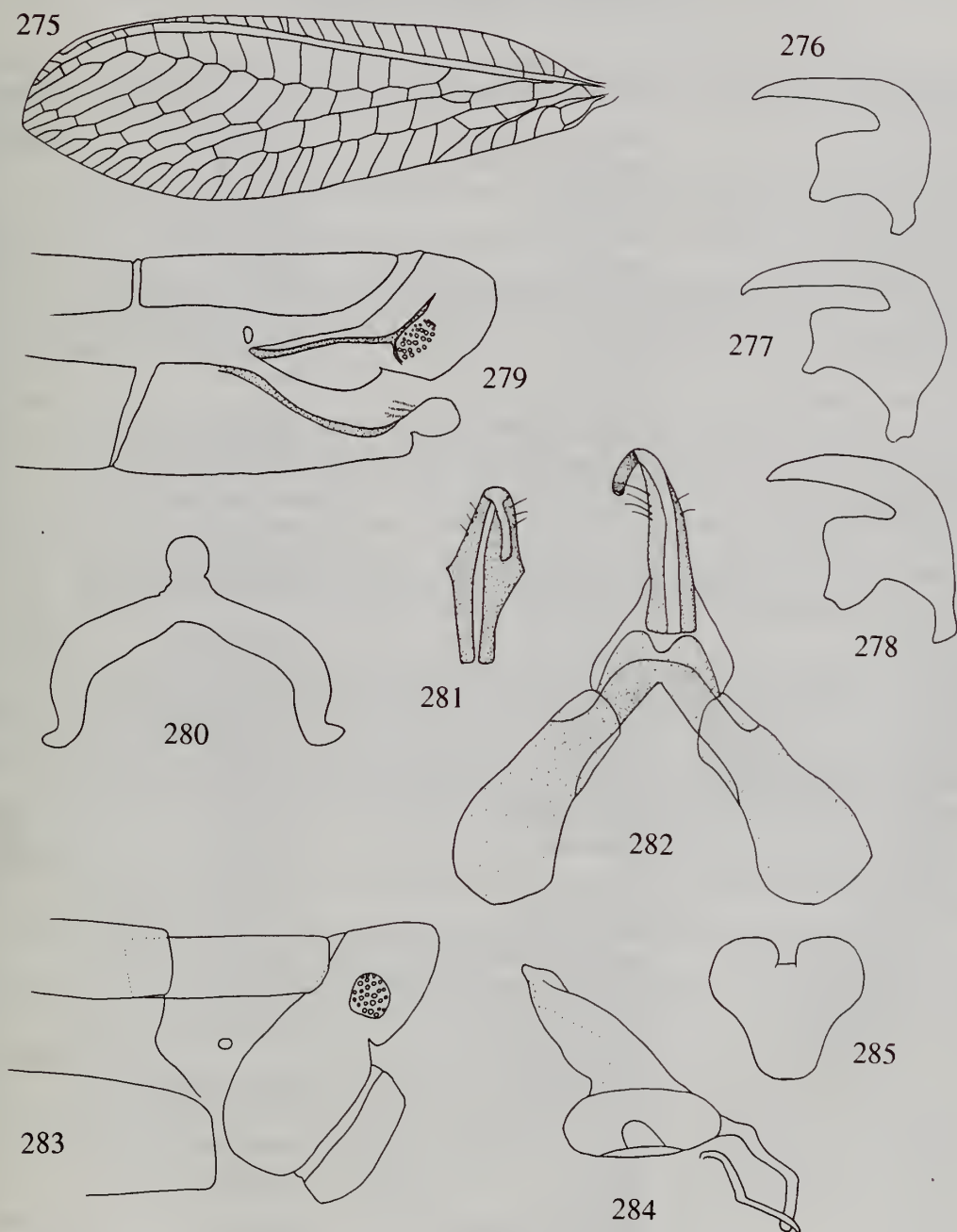
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